SIGNAL

October 1957

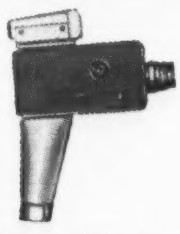
Moon Radar

See Page 3

FRONT-LINE STORY

Seen and heard at Command Post by means of world's smallest TV and Radio Communication facilities

Transistorized radio receiver transmitter completely concealed in helmet has up to 5-mile range.



"Telemite," smallest TV camera, features newly developed RCA ½-inch Vidicon tube, size 1⅞" x 2⅜" x 4¾", weighs about one pound.

The soldier you see carries the new RCA one-pound, postcard-size ultra-miniaturized TV camera connected to a miniature TV transmitter on his back. Concealed in his helmet is a complete radio receiving-transmitting set weighing only a few ounces. He is one of several similarly equipped men covering the battle area from a number of positions in the air and on the ground.

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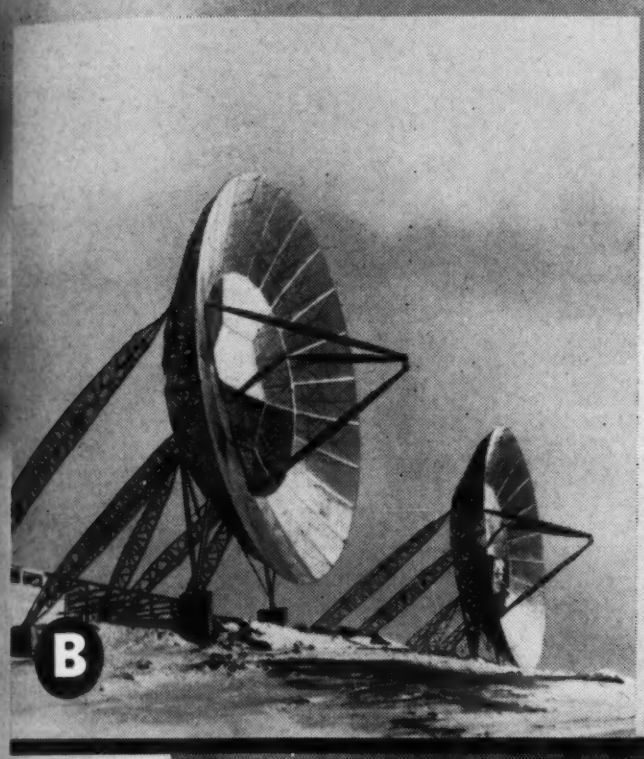
DEFENSE ELECTRONIC PRODUCTS

RADIO CORPORATION of AMERICA

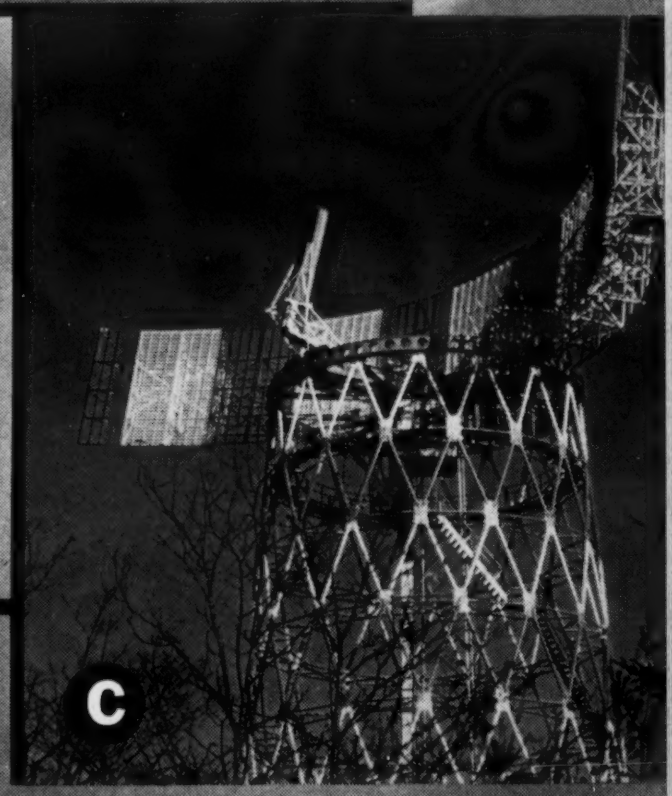
CAMDEN, N. J.

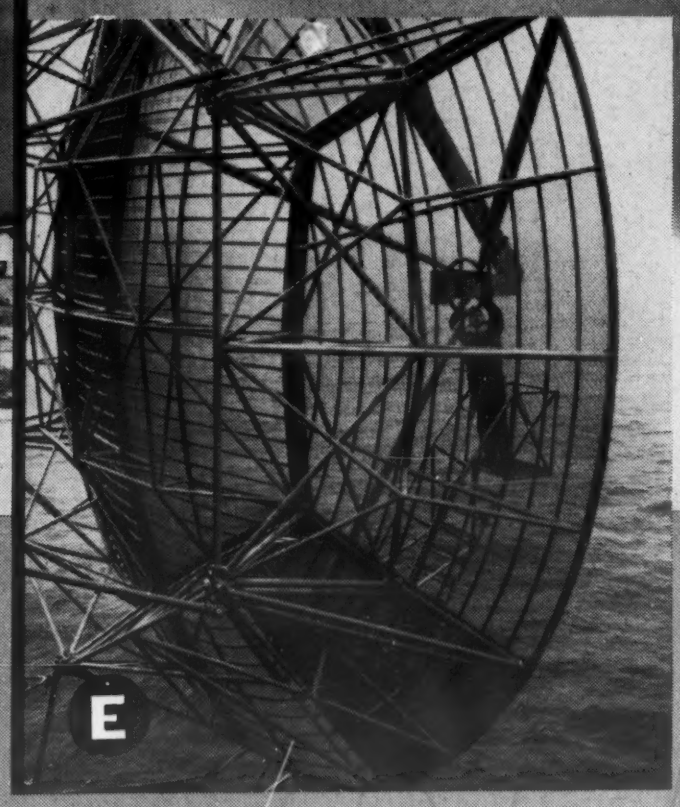
ANTENNA PROBLEMS?

Ask Kennedy!



- **A** *60′ Radio Telescope, Harvard University*
- **B** *60′ Trans-horizon Antennas Northern Europe*
- **C** *120′ Radar Antenna Maine*
- **D** *28′ Trans-horizon Antennas Cape Cod*
- **E** *28′ Trans-horizon Antenna Texas Tower*





The solution to antenna problems begins when someone says: "Let's ask Kennedy!"

A few of the many reasons why are shown on this page. These Kennedy antennas are setting new standards for all-weather reliability and versatility wherever they serve throughout the free world.

Kennedy antennas come in many shapes, many sizes (the world's largest scatter antenna is being built here). But whatever the type, and whatever the conditions under which it must serve, Kennedy can offer a design that fully measures up to specifications. And there are additional advantages in Kennedy's advanced construction techniques — like the extra ease in shipping and handling made possible by sectionalized aluminum construction, for example.

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BPA

SIGNAL

Communications-Electronics-Photography

Journal of the Armed Forces Communications and Electronics Association

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COVER

Someone is communicating with someone in space, and it could be the man in the moon!

SIGNAL*'s cover pictures the giant moon radar antenna, DIANA, which has demonstrated the power to transmit signals strong enough to be reflected by the moon's surface and received by an earth satellite tracking station.*

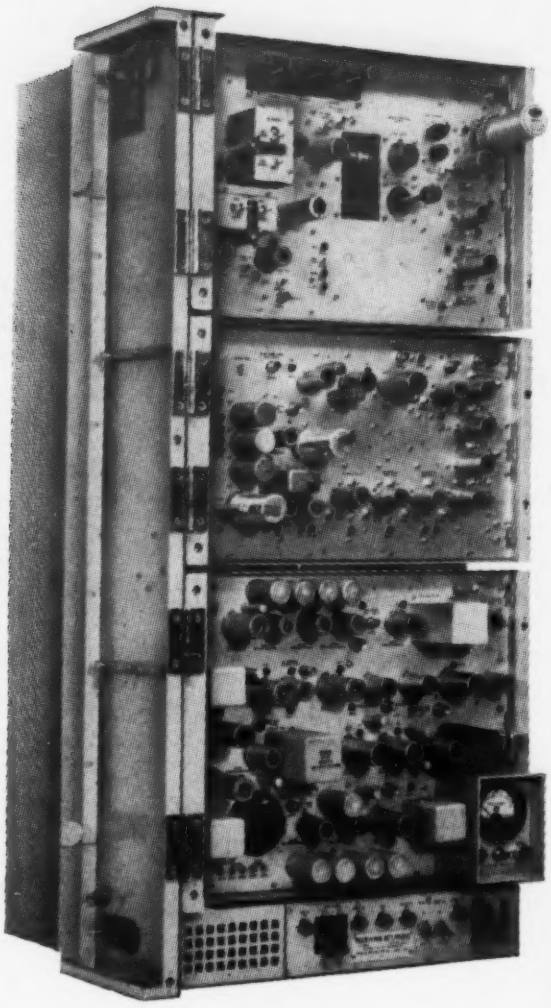
In preparation for Project Vanguard, this powerful equipment was developed by the U.S. Army Signal Engineering Laboratories, Fort Monmouth, N. J., and is currently being used to calibrate equipment in the ten Minitrack radio stations which, when in operation, will report the movement of the earth satellite as it journeys around the world.

Special Notice

For the past year, the Association has assumed the increased cost of publishing a monthly magazine in place of a bimonthly publication. This additional cost, coupled with an increase in production and mailing rates, has been considerable. We now find it necessary to effect the following changes in our non-member rates for renewal of subscriptions to SIGNAL after November 1, 1957. The domestic rate will increase from $6.00 to $7.00; the foreign rate will increase from $6.50 to $8.00.

Authors are entirely responsible for opinions expressed in articles appearing in AFCEA publications, and these opinions are not to be construed as official or reflecting the views of the Armed Forces Communications and Electronics Association.

UNIQUE



Full utilization of the superior characteristics of tropo scatter communication is achieved by REL *combining* diversity receiver equipment. These notable advantages are unique with REL diversity receivers:

1) *Positive improvement in signal-to-noise ratios over single receiver operation, when received signals in each receiver are approximately equal in quality:*
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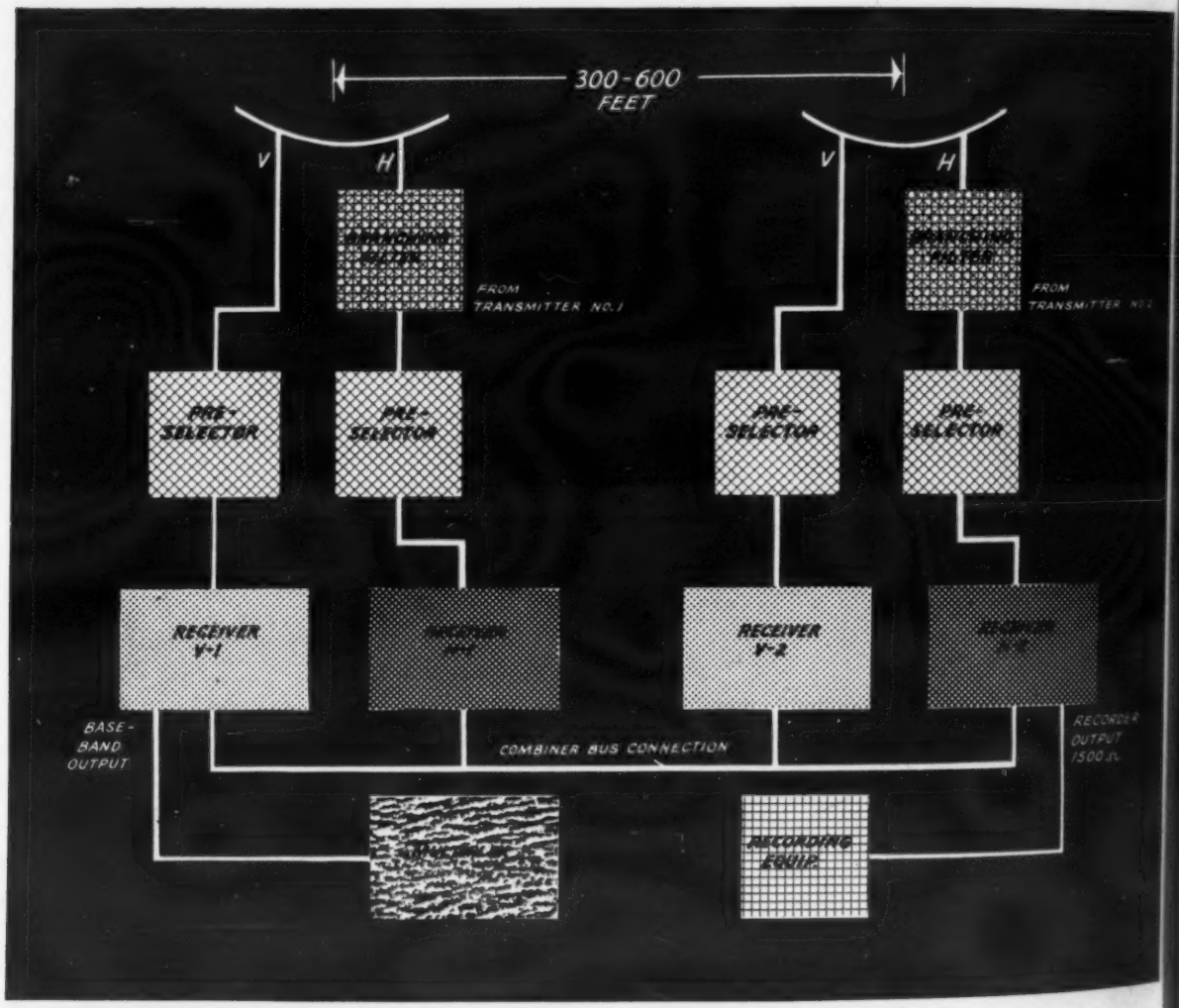
   4.75 db for triple diversity
   6 db for quadruple diversity
2) *Signal-to-noise ratios at least equal to that of best receiver in the diversity combination.*
3) *Circuit reliability enhanced by combining all signal paths.*
4) *Response time of the combining action optimized for both voice and teletype reception to an attack time of 0.2 milliseconds.*
5) *Combiner dynamic response increased to 40 db.*
6) *The adaptability and versatility of all receivers further augmented by a 1500 ohm output for standard graphic recording equipment.*

The same imagination and skills which devised this apparatus are available for solving your specialized radio problems.



Typical quadruple diversity operation of REL combining receiver. Output to multiplex available from all receivers. V = vertical polarization, H = horizontal.

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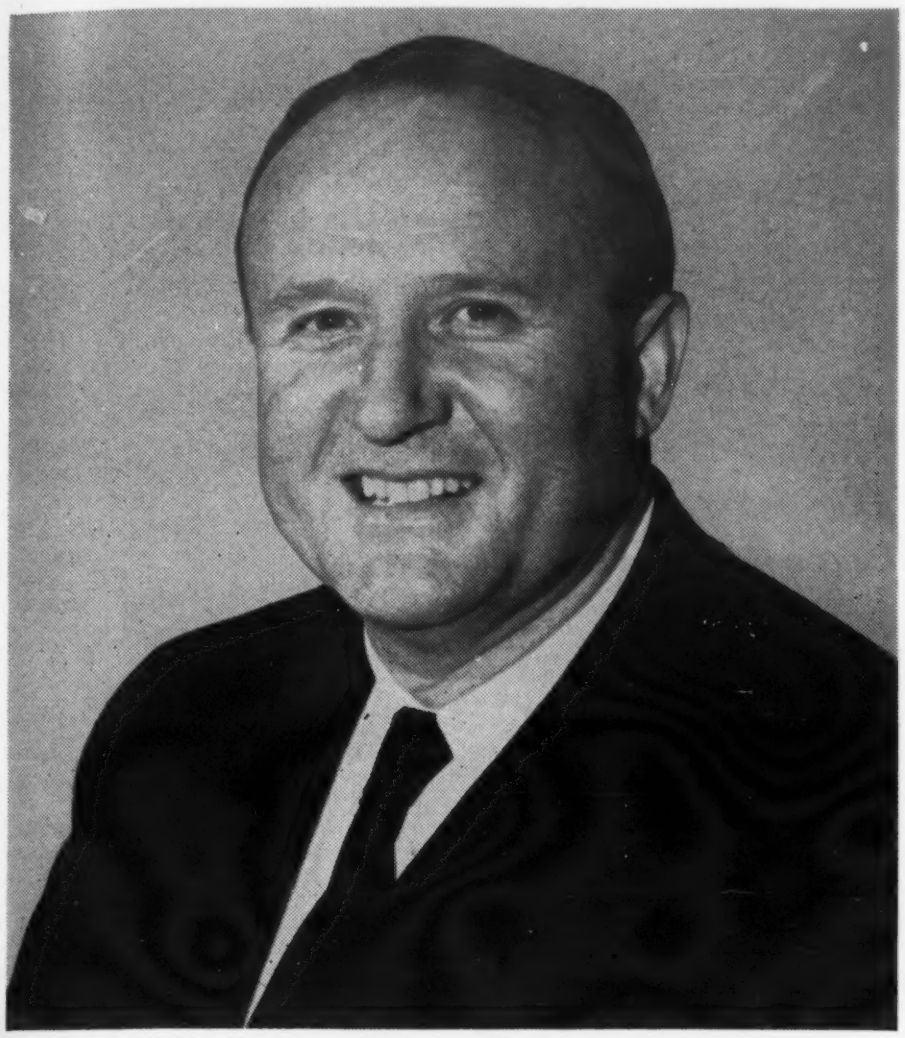

WILFRED B. GOULETT
Captain, USN (Ret.)
Executive Vice President, AFCEA

★ ★ ★

Having retired in 1955 after a distinguished Naval career which had centered his activities in the fields of communications, radio engineering and research, Captain Wilfred Bradley Goulett, USN (Ret.), newly elected Executive Vice President of AFCEA, assumed his new position on October 1, 1957.

Born in Stevenson, Conn., Captain Goulett evinced interest in communications during the early years of his schooling when he became a Western Union telegraph operator. He spent his summer vacations following this trade until his appointment to the United States Naval Academy, for which he had prepared at the Werntz Preparatory School, Annapolis, Maryland.

Following his graduation from the Naval Academy in 1925, and until 1930, Captain Goulett served aboard the *USS California*, the *USS Neches* and the *USS Saratoga*.

In June 1930, he received postgraduate instruction in communications engineering at Annapolis. Subsequently, he continued this study at Yale University where he received his MS degree in 1932. Captain Goulett was then assigned to the *USS Indianapolis* for two years, and from 1934 to 1942, respectively, he was Radio Officer on the staff of Commander Battleship Division TWO; a member of the Radio Division, Bureau of Engineering, Navy Department, Washington, D. C.; Radio Officer on the staff of Commander Battle Force, *USS California*; Fleet Radio Officer on the staff of the Commander in Chief, U.S. Fleet, *USS Pennsylvania*, and Officer Representative for Radio and Underwater Sound at the Naval Research Lab., Anacostia, D. C.

For his extremely meritorious service during the fulfillment of duties as Radio Officer on the staff of the Commander in Chief, U.S. Pacific Fleet (1942-1945), Captain Goulett was awarded the Bronze Star Medal.

Captain Goulett assumed command of the *USS St. Mary's* in 1945 and the *USS Navarro* in 1946, following which he attended and graduated from the Naval War College in 1947.

With subsequent duty in Washington and at sea, he reported for duty in 1950 as Head of the Plans and Readiness Branch, Communications Division, Office of the Chief of Naval Operations. In February 1951, he became Assistant Director of that Division and in August of the same year, was appointed Director.

After a year's service as Commander Transport Division 23, Captain Goulett spent 4 months as Commanding Officer of the Naval Station at Long Beach, Calif. Returning to Washington, he served as Staff Director, Communications-Electronics, Office of the Joint Chiefs of Staff, until June 1954, and then served a year as Group Commander, Long Beach Group, Pacific Reserve Fleet, prior to his retirement on June 30, 1955.

Captain Goulett has the American Defense Service Medal; the American Campaign Medal; the Asiatic-Pacific Campaign Medal; the World War II Victory Medal, and the Navy Occupation Service Medal, Asia Clasp.

AFCEA is pleased to welcome Captain Goulett aboard as its Executive Vice President.

Helping put time on our side

Our nation's defense in the modern world requires quick, accurate communication. With *time* on our side, we'll be better able to meet any defense emergency.

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what price **RELIABILITY?**

by Angus A. Macdonald

Director of Engineering

Communications and

Industrial Electronics Div.

Motorola Inc.

IF YOUR NEIGHBORS ACCUSED YOU of being a thief, a vandal and a traitor you would undoubtedly be shocked and hurt and would certainly protest your innocence. Start preparing your case, because you stand here accused on each of these counts if you have in any way contributed to the present state of poor reliability in our field. Untold millions of dollars are being wasted annually due to our faulty practices in procurement, design and production of electronic equipment.

If you are a contracting officer, a purchasing agent or a design engineer, you have probably contributed materially to this serious state of affairs. Unless our design and purchasing practices are changed and a significant improvement is made in terms of real reliability of electronic equipment, the growth of electronics in our economy is doomed to be self-limiting. I am certain that these practices will change, and are even now being changed because of economic considerations.

It is vital that we all appreciate that poor reliability is largely determined by our design and purchasing concepts and that we take appropriate corrective steps now so that the growth of electronics will not be stunted.

I am convinced that there are four basic contributors to poor reliability in electronic equipment:

(1) Excessive detail in specifications for basically new equipment.
(2) Inadequate experience and training of the design engineer, leading to immature design philosophies.
(3) An inadequate product evaluation program prior to full-scale production.
(4) A lack of continuity of production and use, or a lack of a complete feedback loop from the user back to the designer.

In explanation of these four basic factors, let us investigate first the result of excessive detail in design specifications for new equipment. Where the purchase of new equipment is governed by specifications, rather than experience and competitive performance tests, these specifications are usually written around specific design details rather than providing a comprehensive review of all performance requirements. In writing specifications on design details, it is practically impossible to avoid writing in requirements which hurt reliability.

For example, the specifications of unduly stringent size, form factor and weight limits can lead to poor reliability through crowding and overheating of the components. Oftentimes, also, through a desire to achieve the universal gadget and to make all users happy, the specifications require excessive complexity in the equipment. This is a sure path to poor reliability. A simple thing like the specifications of continuous tuning in a communications receiver or transmitter can seriously degrade reliability. It is frequently found in such cases that the end use does not actually require continuous tuning.

Detailed equipment specifications, to some extent also relieve the manufacturer of responsibility for equipment performance and place this responsibility in the hands of the specification writer. To a large degree, detailed specifications also remove the competitive motive, again because the specification writer assumes responsibility which should rightfully be in the hands of the equipment designer.

Second among our four factors is that the design engineer is probably the one person most responsible for reliability, or lack of it, in any equipment design. It is his basic design philosophies and ingenuity which permit the incorporation of a wide safety margin or, failing that, result in a marginal design. The engineer can be severely hampered by detailed specifications or a complete lack of information regarding the end use or field performance. These are, as we shall see, contributing factors for good or bad. The major responsibility still rests with the engineer.

It is almost impossible for an immature engineer to design a basically sound piece of equipment. A poor choice of components, or a misuse of components, will both lead to poor reliability. However, the fact remains that even if all components are properly chosen and are used within their ratings, the basic design may still be unreliable if the design philosophies do not make maximum use of adequate system margins and "go-no-go" circuitry. The immature or inexperienced engineer does not have the background or knowledge of design history and customer application of the equipment to permit him to achieve the maximum reliability for a given equipment price range. It is necessary to devote considerable time and effort toward indoctrinating new engineers in the optimum design philosophies which are gradually established in a mature electronics field.

Third, as a fundamental factor contributing to poor reliability, is an inadequate product evaluation program. The product evaluation program should be planned to serve as a check on the validity of the basic design, rather than serve as a proving ground where fundamental design modifications are tried out. I think it is safe to say that a sound design will require only minor modifications as the equipment progresses through various tests.

You have all seen cases where an evaluation program showed up the requirement for major design modifications. These situations indicate an unsound design. On the other hand, minor modifications are frequently indicated. It often happens that an evaluation program will show up not only component or design defects in new equipment, but also defects which have existed in older designs. As an example, just recently we had a case where evaluation of a

new design indicated that the crystal oven in a transmitter was not reaching operating temperature in a —30° C ambient. Investigation showed that the heater voltage at the oven was below the design center in other equipments as well as the transmitter being evaluated. This finding led to a change in the design center of the oven voltage. The other equipment had all been previously evaluated and had functioned perfectly in the low temperature environment. How can this happen? It is always amazing how new problems continue to crop up in old designs running in continuous production. *It is often painfully apparent that continuing product evaluation programs are vital to equipment reliability.*

The fourth contributor toward poor reliability is a lack of continuity of production and use of the equipment, or a broken feedback loop from the user back to the designer. In a normal commercial operation the manufacturer of equipment assumes a continuing responsibility for its performance. This responsibility is forced on him by the fact that he must successfully compete over a long period of time if he is to make a profit.

In order to show a profit, a commercial organization must produce a product which not only appeals to the purchaser originally on the basis of value received for the dollar spent, but also continues to provide a performance equal to, or better than, a competitive piece of equipment which might have been purchased and which may be purchased next time. In other words, the customer has to remain sold. Due to this profit motive, leading manufacturers in any commercial field achieve a high degree of maturity in their product as a result of a well-organized and continuing feedback loop from the user to the design engineer. Checks and balances are imposed upon the procedure for bringing out new products so that the product reaches the market at a high point of maturity. In this manner the maximum customer satisfaction is achieved, and the correction of field problems does not burden the producer.

We recently had a case of poor reliability in a particular tube type, which cropped up several years after the tube had been incorporated in production equipment. In this case, the problem was found as a result of feedback from the user. Investigations showed that failure of the heater of the defective tube was occurring as a result of vibration and was damaging other components in the equipment. In this case, failure of the heater usually resulted in a heater-to-cathode short which provided almost normal operation. Therefore, the failure was not evident to the user. However, as long as the defective tube remained in its socket, other tubes and components were damaged. After investigation, it was found that the manufacturer had changed the number of folds in the heater of the tube and had so weakened it that early failure due to environmental conditions was frequent. This was corrected by changing the heater design back to the original, which had provided good reliability.

Note well that in the long run in commercial markets, the manufacturer and not the user assumes responsibility for the reliability of his product.

Unfortunately, military procurement is not now set up on a basis which will permit either a continuing production or a complete feedback loop from the user to the designer. In military equipment the responsibility for the performance of the equipment in the end use is assumed by the *user* rather than being properly brought home to the equipment manufacturer.

Naturally, if the electronic equipment is built in accordance with detailed technical specifications supplied by the user, he must, of necessity, assume a large degree of responsibility for the product he receives. However, this is an artificial situation. In commercial markets you will generally find an extremely high degree of reliability at a reasonable price, not only in electronic equipment but in other complex designs because the profit motive remains as a continuing factor in the product evolution.

Control of Fundamental Factors

What must be done, then, to achieve a high degree of reliability in both commercial and military electronic equipment? A program must be established which recognizes and makes a specific effort to control the fundamental factors contributing to reliability:

(1) Detailed specifications should only be written to permit duplication of existing equipment. In any other case, specifications should permit sufficient latitude to achieve the desired reliability.

(2) Top engineers with long experience in the particular field involved should be responsible for new development.

(3) Component evaluation and selection must be made with the end use in mind.

(4) A specific program for equipment evaluation prior to production and continuing during product life must be established.

First, unless you have a finished piece of equipment which reliably performs the task it was designed to do, you should not write detailed specifications. To do so implies that the specification writer knows all that is required to obtain an optimum design for that equipment. Specifications which are written on *new* equipment to perform a *new* task should specify the reliability required and should concern themselves principally with considerations of the environmental factors to be encountered. They should detail the input and output requirements, and they should give the broadest possible interpretation on size, weight and form factor limitations. This type of specification will permit the designer actually to incorporate reliability as a prime consideration in his design rather than an afterthought.

Second, the key engineers responsible for the design should be the best and most experienced that can be found, not only by reputation but as judged by actual past performance. The key engineers should be completely familiar with the end use requirements for the equipment and should be well versed in the particular field involved in the design. The basic philosophy of the design should aim toward the achievement of the maximum possible safety factors consistent with economic and space considerations. The engineer should appreciate the vital importance of "go-no-go" circuitry as contrasted to proportional. He should establish optimum basic design and then find out how to achieve it within the dollar budget. Oftentimes, the exercise of considerable ingenuity will lead to a design philosophy which yields a higher degree of reliability than prior, similar designs. For this reason the best engineers are required for any fundamental design projects, even small ones.

Third, as the basic design concepts are established, component selection and evaluation will play an important part in the over-all reliability. It is this stage that determines the detailed reliability for the inital design. It is also component selection which is most frequently affected by both in-plant evaluation tests and feedback from similar field uses.

Finally, a specific program should be established for equipment evalua-

tion prior to production, and if you are really serious about desiring a high degree of reliability, it is necessary to set up a system whereby continuing feedback may be established between the user and the design engineer.

In order to achieve the continuing feedback loop and the benefits from well-qualified and well-trained engineers, it will be necessary for military procurement to establish some new policies:

(a) Different types of electronic gear should be purchased on a continuing competitive basis from at least two sources. Competition should be based on both price and performance of the equipment. Performance should be evaluated as a result of feedback from the actual user in the field. Correction of reliability problems should be done on a continuous basis.

(b) The soundness of the fundamental design should be established, not only by an evaluation program but also by the qualifications and training of the engineers responsible for the design. This means, for example, that communications equipment should be purchased from manufacturers who have a position in the communications field, and not from an untried organization which is low bidder.

Let's put competition and the profit motive to work for the military to help achieve reliability rather than to hurt it.

In commercial communications products we have found that the optimum results are achieved by the following seven programmed steps in evaluating a new product:

(1) The breadboard design is evaluated to determine that the basic philosophies are sound and that it is producible by standard techniques which are capable of providing a high degree of reliability.

(2) A preliminary model is screened by engineers, manufacturing personnel, field quality control and field service personnel. At this screening, all factors affecting producibility, reliability, serviceability and customer satisfaction are reviewed. Design modifications are made as a result of this screening. In some cases it may be necessary to hold a second screening meeting if the design modifications are extensive. In any case, approval of the product leads next to a production pilot run. The quantity involved in the production pilot run is based upon the quantity to be produced. It has been found desirable to run extensive pilot runs on equipment to be built in large quantities. The pilot run not only permits an evaluation of the product itself, but also indoctrinates all phases of the production activity.

(3) The pilot-run equipment is given a complete in-plant evaluation consisting of special engineering tests to determine that the design centers are properly established. In addition, the equipment is checked completely by environmental tests. Subsequent to this, pilot-run equipments are put in service in the field in a planned program to obtain field evaluation and accelerated follow-up on any problems which arise. After this program has established the validity of the basic design, production is started.

(4) The first units off the production line are again evaluated in every respect by special engineering and environmental test to make sure that the production product is the same as the pilot run.

(5) As production continues, inspection and tests of incoming components and finished goods assure that the manufacturing quality remains at a high level.

(6) Spot checks of the production units in great detail by a superposed quality control group give assurance that the production quality continues to meet the bench marks established in the pilot run.

(7) Once production has been started on a continuing basis, feedback from the user to the designer, or the engineer responsible for the design, assumes a position of major importance in furthering product maturity. In order to achieve the greatest advantage from the feedback loop, it is essential that the communication path from the user to the engineer having design responsibility is as short as possible. This makes it desirable that the engineer visit user groups at frequent intervals to discuss their problems and the application of the product.

Despite all the checks and balances which have been installed up to the point that the equipment is shipped to the field, it has been found that the omission of the feedback loop can permit serious reliability problems to creep into the product and build up to gigantic proportions prior to correction. The closed loop, on the other hand, permits the proper emphasis to be placed on field problems so that by process of successive approximations, the design is improved and maintained at a point of maximum reliability. It should be pointed out that it may be necessary as a result of field experience to institute research programs to solve reliability problems which are encountered as the life of the equipment continues. It has been found that careful sifting of user complaints or criticisms will yield early information regarding a potential reliability problem.

Some Basic Steps

We should all agree to stop weighing down our economy with immature equipment and take those steps required to achieve electronic equipment with a maximum of reliability. The four major steps required are:

(1) Write specifications on equipment operational requirements for new equipment, rather than design details.

(2) Adopt basic design philosophies which will yield the maximum reliability for a given dollar invested. This is best accomplished by experienced engineers.

(3) Adopt component evaluation programs to provide components having maximum reliability for a specific application.

(4) Provide an extensive equipment evaluation program which assures a maximum of reliability prior to starting production. Also provide a closed feedback loop from the customer to the designer to mature the product on a continuous basis.

Maximum reliability is achieved as the result of an arduous process of successive approximation toward an optimum solution, and not as a result of a one-shot command performance. If we are to assist the growth of electronics, we must promote the achievement of maximum reliability for both commercial and military equipment.

DOPPLER SYSTEMS AID FUTURE AIR NAVIGATION

by William J. Tull, Vice President

General Precision Laboratory, Inc.

a Military Contribution

THE FACTS AND FIGURES OF A NEW page in the history of air navigation, the Doppler page, have been released from security classification, and the operating techniques and accuracy that have revolutionized military air navigation in the past few years can now be revealed by General Precision Laboratory (GPL) of Pleasantville, New York.

Articles on Doppler navigation have appeared before, but the true impact of the systems, the remarkable accuracies and simplicity, and, as a result, the implications of these systems for commercial aircraft, awaited the recent Department of Defense release of GPL figures.

The navigation systems are completely self-contained within the aircraft. They operate by transmitting microwave energy to the ground and measuring the return reflection. The Doppler shifts, the difference in frequency between the transmitted and "echo" signal, give the pilot of today the basic information he needs for navigation, the ground speed and drift angle.

When connected to a variety of computers and heading references, the Doppler systems become completely automatic, and allow the pilot to fly "no hands"—anywhere, over the best and shortest routes, in any weather, over any terrain, over the poles, over water and at the best altitudes, taking advantage of the most favorable winds.

Accuracy of the System

Accuracy of the Doppler systems, as revealed in figures obtained from hundreds of flights and now released for the first time, is the best recorded anywhere—so good, in fact, that the computers, the compass and human observations contribute far greater errors in over-all navigation than do the Doppler components.

As far back as 1951, a GPL prototype APN-66 system installed in an Air Force B-29, navigated the aircraft 2,400 nautical miles from Seattle, Washington, to Miami, Florida, with a previously unheard of 9.4-mile gross position error of 0.4%.

In 95 long-range flights over distances, in some cases, of several thousand nautical miles, the prototype APN-66 recorded probable range errors of 0.17%, probable transverse errors of 0.16° and probable system position errors of 0.63%. And these were total system errors, a figure combining errors in the computer, compass, human observation and the Doppler equipment. Over 500 shorter range flights have brought comparable results, the figures reveal.

Whereas previous wind errors and ground speed errors were so serious that further development of a precision compass seemed unnecessary, with GPL's Doppler equipment, the tables have been turned. Wind information and ground speed are now so accurate that errors in the compass itself introduce the major system accuracy problem.

The GPL APN-66 is referred to as a "one-percent" system, a system with specifications calling for total errors of less than 1%. Actually, the performance far exceeds the specifications, as shown by the 0.63% figure mentioned above. It operates at altitudes up to 70,000 feet and at speeds greater than the speed of sound.

Errors in the Doppler components of the "66" were so insignificant compared to over-all system errors that relaxing some of its rigid specifications has led to the development of another GPL Doppler system known as RADAN. This compact system was specifically and conceptually designed to reduce equipment weight and is not a transistorized version of the larger systems. It trades small additional errors for great savings in weight and space and, altogether, probably represents the highest state of the present art.

RADAN equipment consists of an antenna-receiver-transmitter, a frequency tracker, one small control panel and a display panel. Ground speed with accuracies of 1% or better, and drift angle, accurate to ½° result from this equipment, although the system weighs only 89 pounds and occupies just 4.4 cubic feet of space. RADAN has altitude capabilities of 70,000 feet and speed capabilities up to 1000 knots.

Combined with computers, RADAN equipment gives position, course, destination and other information roughly comparable to the APN-66. Over-all system performance with a certain computer can make the RADAN computer combination a "two-percent" system, yet weigh as little as 150 pounds.

Janus Techniques

All of the present GPL Doppler equipments utilize Janus techniques, so named after the mythical diety who looked forward and backward at the same time. Four pulsed microwave beams, two forward and two rearward, are transmitted from the plane in pairs, front-right and rear-left, then front-left and rear-right, at a carrier frequency of 8800 mcs.

A Doppler shift in the frequencies from one pair is compared automatically to the shift from the other pair. When a difference is discovered, this "error" signal actuates a servo-mechanism that drives the antenna to a position exactly lined up with the ground track. The difference between how the antenna is pointing and how the plane itself is pointing is the drift angle.

With the Janus system, when the difference between the pairs is eliminated, the actual measure of the Dop-

(*Continued on page* 12)

and in knowing how...EXPERIENCE is the key factor

Lewyt's Coordinate Data Printer is designed to operate interchangeably with two types of Lewyt-developed Coordinate Data Monitors. This new Printer provides for instantaneous recording of target data displayed by the monitors.

Lewyt experience in working with such government research centers as Air Force Cambridge Research Center, Air Research and Development Command...and M.I.T.'s Lincoln Laboratories, has produced unusually effective data processing and data transmission equipment.

For example, the Coordinate Data Printer developed by Lewyt in close cooperation with the Air Force Cambridge Research Center and M.I.T.'s Lincoln Laboratories was actually designed, engineered and *the first production model delivered* IN JUST SIX MONTHS!

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LEWYT

pler shifts from the return echoes are proportional to the ground speed.

The many economical and practical advantages of a Janus system relate to the high accuracies obtained with very low necessary tolerances. For example, if a return echo must be compared to a transmitting frequency (as in non-Janus systems) it becomes crucial that the transmitting frequency be stable and known with great precision. Manufacturing of such transmitters, as well as maintenance, becomes difficult. Also, constant temperatures in the plane become necessary and expense becomes exorbitant. With Janus techniques, because beams are pulse propagated in pairs, only the echoes are compared. Therefore, if the transmitter has wandered off frequency, it does not matter.

Also, for 0.1% speed accuracies, non-Janus systems must know the vertical position of the antenna within 1/50th of a degree. With Janus techniques, knowing the vertical position of the antenna within 2 degrees will produce the same 0.1% accuracies. Again, the advantages in cost, ease of manufacture, ease of maintenance, etc., appear overwhelming.

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The history of GPL Doppler equipment development goes back to 1944 and 1945 before the General Precision Laboratory was organized. In an article written for the MIT Radiation Laboratory Series in 1944, the author outlined the basic Doppler techniques that could replace radar fix-taking procedures and achieve accurate ground speed and drift angle measurements automatically.

Several proofs that Doppler could not work for aerial navigation held widespread acceptance until Dr. France B. Berger, now GPL's Director of Research Planning, using Quantum Mechanics and Relativity Theory, proved that earlier assumptions were wrong.

The company was organized as a subsidiary of General Precision Equipment Corporation in November, 1945. Later, the first ground speed and drift angle measuring device utilizing Doppler shift was "flight tested" from the top of a prewar Mercury automobile at the young company's Westchester County Airport facilities.

Joint Venture

Combined talents of GPL personnel and personnel of the Wright Air Development Center, Wright-Patterson Air Force Base, Ohio, solved the theoretical and practical problems that confronted Doppler development. In 1947, the first Doppler effect ground speed was measured in flight by an experimental forerunner of the APN-66. In April 1948, both ground speed and drift angle were measured for the first time in another experimental forerunner of the present systems.

The first complete automatic navigation gear incorporating these components was flown in 1949, and in 1951, GPL's APN-66 (XA-1) began navigating the series of flights which compiled the records for accuracy and performance described above.

Quantity delivery of GPL Doppler systems to the Air Force since 1954 has stamped GPL as the world's leading manufacturer of such equipment. From its beginnings in 1945 with some twenty "Radiation Laboratory" men, it has grown to a company employing more than 2000 persons.

Cooperation with and encouragement from the United States Air Force throughout GPL's history has now culminated in the release of these systems for commercial as well as military aviation, further indication of the military contribution to developing the commercial products of the future.

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MICROLINE 539 SPECIFICATIONS

VSWR Ranges	1.05–1.3±5% 1.3–2.0±5% 2.0–3.0±10% 3.0–10.0 uncalibrated
Freq. Range	8.5–9.6 kmc
Waveguide Connection	RG52/U (1 x ½ waveguide) or RG51/U (1¼ x ⅝ waveguide) through accessory adapter
Dimensions	Length 19¼ in. Width 12 in. Height 10¼ in.
Weight	35 lbs.
Power Requirements	105–125 volts, 50–1000 cycles 75 watts

*Microline** 555 Klystron Signal Source operates klystrons up to 3600 volts

A universal power supply and modulator for klystrons requiring up to 3600 volts, the Microline 555 also operates traveling wave tubes. It is used as a microwave source for measurements and testing experimental equipment. Main features include precise voltage regulation (0.025% max. variation), internal modulator which supplies sawtooth, sinewave or squarewave modulation to tube, convenient controls and repeatable settings.

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MICROLINE 555 SPECIFICATIONS

	ANODE	REFLECTOR	GRID
Voltage Range:	−250 to −3600v	0 to −1000v	0 to −300
Max. Variation:	0.025%	0.02%	0.02%
Max. Ripple Voltage:	10mv	5mv	50mv
Current Range:	0–120ma (250 to 1250v) 0–15ma (1250 to 3600v)		
Power Requirements:	115v ± 10%, 50-60cps, 500w		
Dimensions:	19¼"W x 21½"H x 15"D		
Weight:	151 lbs.		

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miniaturization

by W. W. Hamilton, Elgin National Watch Company

Manager, Commercial Sales, Micronics Division

MINIATURIZATION, LIKE automation, has been cursed by a variety of definitions that usually fall short of properly identifying the subject. I am not going to complicate this situation further with a new definition, other than to explain what we at Elgin feel is the logical picture.

At Elgin, for nearly 100 years now, we have dealt with things miniature, a factor which has set a pattern for making, gauging, inspecting and handling subminiature, and sometimes microscopically small parts and assemblies with considerable skill. Basically then, we are on firm ground from the point of heritage alone when speaking about miniaturization, especially as concerns its application to day-to-day mass production.

Elgin entered the commercial field of miniaturization less than two years ago because we were getting increasing requests from outside concerns for help with miniaturization problems. From the outset, the response to our entering this field was most encouraging. The success of the venture in so short a time has more than justified our decision.

An example of the type of problems the average manufacturer can have with miniaturization was brought to our attention not more than a month after our new program started. We were called upon by an established manufacturer of special control devices for help in producing a miniaturized version of one of their most successful items. It is important to note that they had already designed a smaller version of the device, a sensor, but realized they had no machinery or know-how to produce it. One of their chief problems was dimensional tolerance. They had no idea what strengths or stresses each pinion, pivot, fly-ball arrangement or plate should have, nor what materials to use to achieve these factors.

Elgin was permitted to re-design any part or major assembly in the device. We successfully delivered prototype models which are now under test for use in jet aircraft.

How was the job accomplished? First of all, our design engineers worked with the customer, learning necessary data to permit their intelligent re-design of the unit. It had already been established that manufacture would be directed by the size of Elgin's machines which were capable of producing a truly miniaturized version of the sensor. In actuality, we reduced the unit by a ratio of 5 to 1, or when figured cubically by a ratio of 100 to 1.

Parts Density Theory

We applied what is called the parts density theory to the job. It works this way: One of the smallest precision mechanisms made at our plant is, of course, the movement for a ladies' wrist watch which consists of nearly 125 parts in an area the size of three dimes stacked together. This works out on a cubic inch measurement basis to about 104 parts per ¾ cubic inch of space and determines a size base to which our machines and personnel are normally geared, and which would not necessitate new, over-all tooling.

In the case of the sensor, we determined the number of parts needed and projected their reduction in size on a per cubic inch basis to learn whether or not the re-designed item would be in the particular size range for this project. This method also permits a close look at the device when it is broken down into its component parts and often permits simplification of several sections of the device as well as the employment of different principles than were used in its larger counterpart. Elgin engineers designed the fly-ball arrangement in the sensor by using a new spring made of watch alloys and it was this fly-ball that was the size determinant for our miniaturization project.

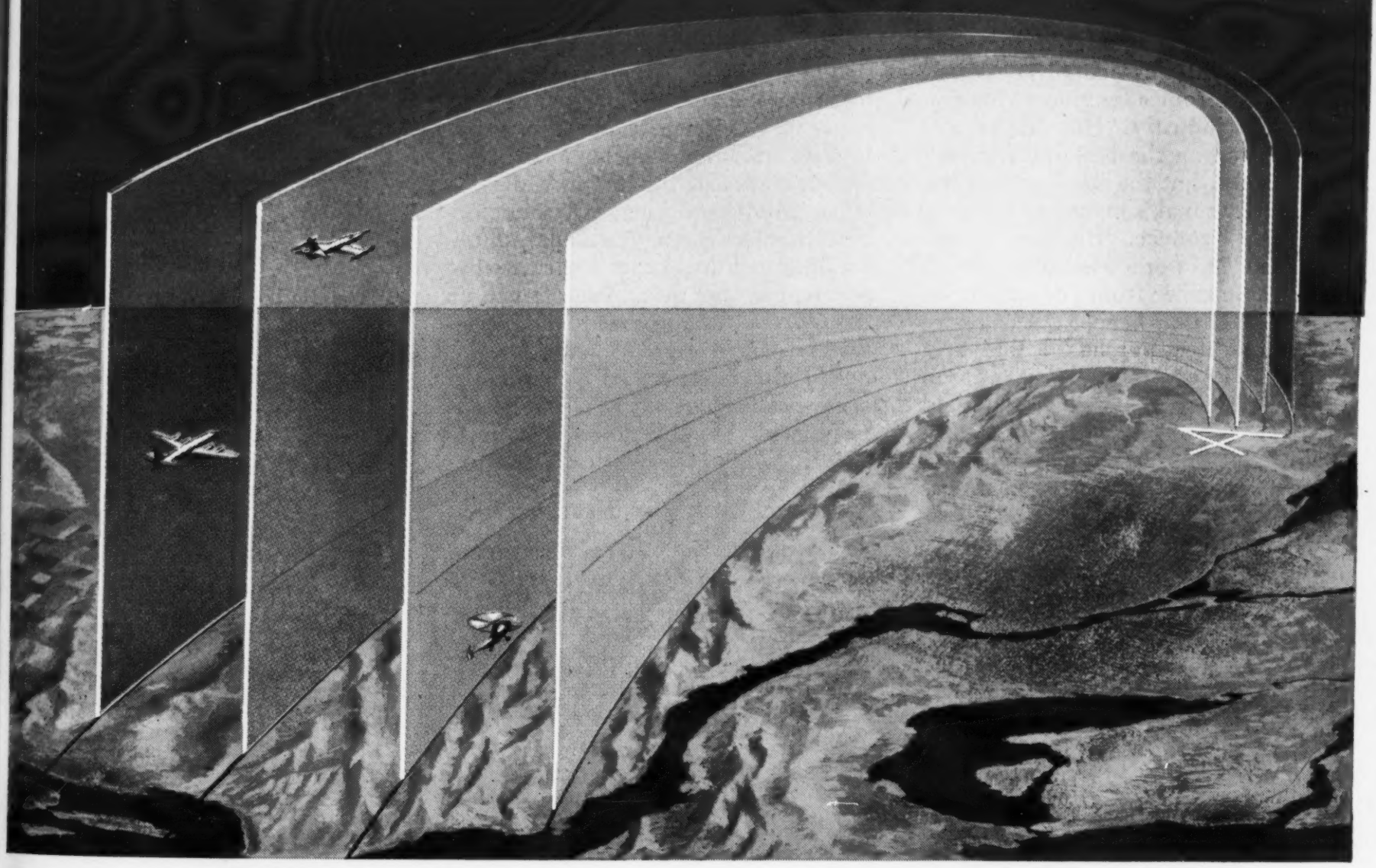
Recently a design engineer for a leading aircraft company, whose job it is to procure electronic components for his firm's planes, described electronic miniaturization as a mechanical problem. The hue and cry from the electronics industry today is not, "*can* we make it?" It's, "*how* do we make it?" As this aircraft design engineer said, the problem is one of mechanical abilities — the ability to design and build special machines, tools, gages, jigs and fixtures, that will produce the almost microscopically small parts that are needed for lightweight, tiny electronic components.

The problem is increased by the lack of personnel equipped to handle these small parts, much less make the necessary machines. This is one of the chief areas where, I believe, the watch industry can help because we have long experience in skills that are not learned in a hurry. The men who make our tools and dies have at least 10 years experience. Those assigned to build a shaped punch with a diameter of .004 of an inch, something they cannot see with the naked eye, usually have more than 14 years experience.

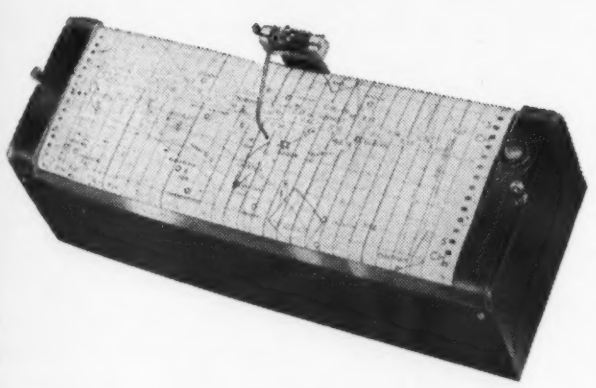
Many dies in the watch industry are of the compound, sub-press category (incidentally, invented at Elgin) and are capable of stamping precision-located pivot holes in a plate not larger than a grain of wheat. A miniature relay plate, armature assembly, or potentiometer plate requires the same machining know-how. This work is, of course, accomplished on special machines, many of them made at Elgin, and which are inherent to the watch industry. It is only recently that they have been turned loose on commer-

(*Continued on page* 16)

TRACKS IN THE SKY



...with the Bendix-Decca Area Coverage Navigation System



The actual position of the aircraft is continuously traced on the Flight Plotter—a moving road map of extreme accuracy.

In California in 1941, when two midwesterners invented a new navigation system, they didn't dream how much "growth potential" it had. Today that system is not only the most thoroughly proven navigation system in the world, but recent developments combine to give it outstanding air traffic control capability.

The Bendix-Decca system permits maximum utilization of air space at all flight altitudes — along airways or in terminal areas. It continuously shows instantaneous position location to the pilot, *with precision never before approached,* thus permitting minimum track separation, so essential to effective air traffic control.

Fixed wing aircraft and helicopters can maintain holding patterns with absolute accuracy and can feed into an approach system from any point with complete certainty.

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PACIFIC DIVISION
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NORTH HOLLYWOOD, CALIF.

cial devices foreign to the horological field.

Today's requirements in the electronics industry make it necessary for electronic designers to familiarize themselves with the capabilities of these types of machines to enable them to design within their size ranges.

Many of you are familiar with the Neomite relay made at Elgin, but only a few know of the history of this tiny switching unit, no bigger than a pencil eraser. It is important to note that it was actually designed by an electronics engineer outside the watch industry. His design was good, based on the best relay theory then known, but the item proved too small for his firm's machinery or personnel to produce. His first prototype models were assembled by a local watchmaker from parts made by him at his repair bench.

Elgin Watch purchased this firm nearly two years ago and was fascinated by the Neomite which then had been placed on the shelf as unproducible. It was turned over to watch engineers and they began a year's study to work out, according to watch techniques, methods that would allow its mass production.

More than 10 basic designs were laid out, including a new type of armature assembly and the use of tiny threaded screws to precision adjust the contacts in the relay. These screws are so small it takes more than 8000 of them to fill a thimble. Because they were made of silver, it was decided to use the screw itself as the contact in one application.

The armature was designed to function similarly to the pallet or balance control arm in a wrist watch, which permitted accurate and continuous operation without having the armature jumping out of action. A tiny coil for the relay was made on a special coil winding machine designed and built at Elgin nearly five years before, during development work on an electronic wrist watch. The Neomite coil, by the way, is no bigger than the head of a paper match.

Mass production of the relay was accomplished by a team of operators with an average of 5½ years of experience working with tiny watch parts and assemblies, and capable of using vacuum screw drivers, watch tapping machines and other special tools. Machining tricks that made mass production possible included knowledge of special alloys used for contact springs, precision die-stamping for the coil frame and watch gauging methods to govern quality control on parts so tiny that each must be assembled into the final unit with the aid of magnifying lenses.

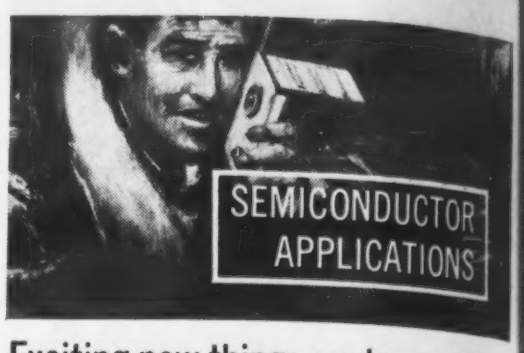
Part of the miniaturization approach must be considered as a *frame-of-mind* — actually, the ability to think small — from the standpoint of the design engineer, the tool maker and the production engineer. It is this frame of mind that has become a part of the watch craftsman's true miniaturization skill—his ability to approach a miniaturization problem with confidence because it's in "his neighborhood." I would add that current procurement policies are often unrealistic as concerns the producer of single-source items, especially with miniaturized components. It is tough enough for one manufacturer to produce a tiny, precision device to meet some particular application, much less expecting several to accomplish this task. Use of such an item gives the producer the necessary stimulus to continue to push ahead the frontiers of progress by spear-heading new research and development of miniaturized components.

Free Rein for Designers

Miniaturization of necessary components should not suffer because of individuality.

In summary, I would say if you enter miniaturization, be prepared to give your design engineers a free rein to toy with new designs of old established devices. Let them enter the "dream world" of smallness. Successful miniaturization usually entails some untried method or principle, and always requires re-design.

New emphasis must be put on your tool and die facilities and personnel. You can expect to make more *in-plant* machines since there are few outside the field who will even attempt to make what you need. The use of new materials will necessitate broader knowledge, longer learning time and new equipment expense, especially as concerns plastics, metals, ceramics and resins. Smaller parts mean finer gauging, increased inspection and quality control, as well as the use of special optical projection equipment scaled up as high as 100 to 1 just to see what you are doing. Miniaturization demands on-your-toes research and development to keep pace with what's available to help you, often in fields far removed from your own. And finally, it demands that new frame of mind—that ability to think small. You will know you have achieved it when the impossible of today becomes the commonplace of tomorrow.



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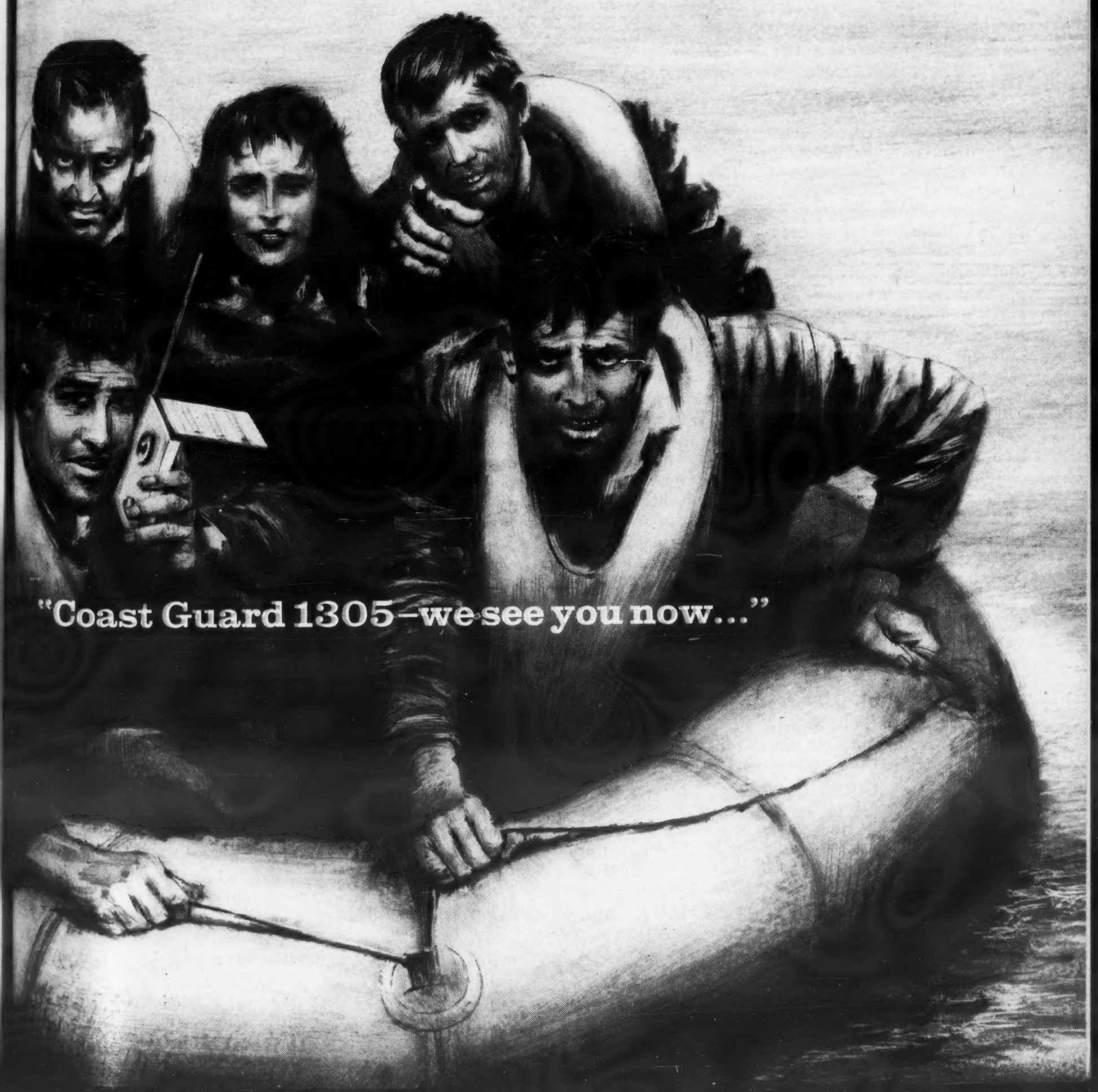

THE IBM 704

its many applications

THE IBM 704 DATA PROCESSING System, a large-scale electronic digital computer, is a machine capable of various complex applications. The most familiar of these is the proposed orbital calculation and prediction of Project Vanguard's first satellite.

When the Navy launches the satellite during the International Geophysical Year, the 704 will play an important part in providing scientists with valuable data. Linked to a global network of official tracking stations, the computer will operate at electronic speeds many times faster than the satellite will move. Data will be received from each station in turn, and the 704 will produce predictions of the satellite's motion, including expected times of passage and a description of its arc. These forecasts will help observers at posts next in the path to make the most accurate measurements possible.

This artificial moon will serve as a carrying case for scientific equipment and collect information about temperature, particle density, meteoritic collisions, magnetic flux and energy emitted from the sun. In addition, the satellite itself will react as a sensitive instrument whose orbital fluctuations will reflect variations in the structure of the earth.

Once the orbit has been established and reliable, long-range predictions have been made, the IBM 704 installation will continue to process incoming data, enabling better forecasts as more complete information is obtained. At the same time, this data processing system will start the giant task of analyzing all intelligence stored in its "memory file" to produce a complete definition of the satellite's orbit.

The information gathered will enable scientists to understand better the cosmic forces which influence life on earth—forces which are almost entirely hidden from study by the blanket of air surrounding the world.

It is known that this relatively dense filter absorbs most of the radiant energy from the sun and causes many meteorites to burn out as they approach the earth at high speeds. But virtually nothing is known about the composition or behavior of the upper atmosphere and even less about conditions farther into space. If this planet and the forces which act upon it are to be understood, these important outer regions must be observed and analyzed. Consequently, methods for placing instruments beyond the atmospheric barrier are needed.

Until recently, rockets have been the only technique for penetrating the ocean of air blocking the view. Although they have collected a large amount of valuable data, the rockets' usefulness is limited. Each missile briefly records conditions above only one location and then quickly falls back to earth. An outpost on the edge of space is required to gain sufficient knowledge of the forces.

Man-made satellites will provide an answer to this need. Carrying scientific instruments high above the atmospheric screen, they will gather information over large areas for extended periods of time. Such information will be relayed to the 704 located at the Vanguard Computing Center in Washington, D. C. This computer, to be operated under a Navy contract by International Business Machines Corporation, is one of more than two score 704 machines now in the field.

The other computers are either now performing or scheduled to handle numerous other functions. Designed primarily for scientific and engineering calculations, in one second the 704 can perform 40,000 additions or subtractions or 5,000 multiplications or divisions of 10 digit numbers. These characteristics make possible the following applications:

The Midwestern Universities Research Association (MURA) is using the 704 in connection with development of a synchrotron, an atom smasher of radically new design. The new accelerator is such a tremendous leap forward in power that it will open up untouched fields for study. MURA, with headquarters in Madison, Wisconsin, is a group name for a non-profit corporation formed by 15 Midwestern universities for research and development in the field of high energy physics.

In Santa Monica, Calif., a 704 at Rand Corporation features the first model of an expanded high-speed storage unit which will more than double the effectiveness of the computer on many problems. Rand will use the 704 with enlarged memory to work problems in many areas, including the calculations of fall-out of

radio-active particles following nuclear explosions.

At General Electric's jet engine plant outside Cincinnati, a 704 is conducting automatic simulated flight tests of aircraft and engines still in the design stage. Air frame and engine performance data are fed into the computer on cards, and the desired information on the performance of the proposed airplane is turned out by the 704 in short order —often as short as 20 seconds.

Most of the intricate components and circuits to be built into the IBM "Stretch" super-computer will themselves be designed with the aid of computers, notably the 704. "Stretch" is being developed by IBM for installation at Los Alamos Scientific Laboratory, operated for the Atomic Energy Commission by the University of California. Its speed is expected to be about 200 times that of the fastest general purpose computers in use today.

In Arlington, Va., the Council for Economic and Industry Research, Inc., used a 704 to figure the direct and indirect effects of the nation's 13-year highway-building program on 190 industries. In addition to calculating the impact on each industry, the machine determined that the program will create an average of 880,000 jobs a year. Computing time: 40 seconds.

At Massachusetts Institute of Technology, a 704 installed in the new Karl Taylor Compton Memorial Laboratories is the first of its type to be used wholly for teaching and basic research. Made available by IBM, the machine will be shared by other New England colleges and universities for research and education in computing techniques.

North American Aviation, Inc., has three 704's in operation in Los Angeles to accommodate the company's accelerated research and development program in the areas of supersonic aircraft, missiles and rocket engine design.

A 704 at the Livermore site of the University of California Radiation Laboratory, operated by the University for the Atomic Energy Commission, is working on basic science and on classified problems connected with nuclear weapons development.

With these varied applications, the 704 Data Processing Machine has demonstrated its versatility. When the satellite is launched and useful information is provided to trackers and observers around the world, the computer will establish its value to science in the conquest of space.

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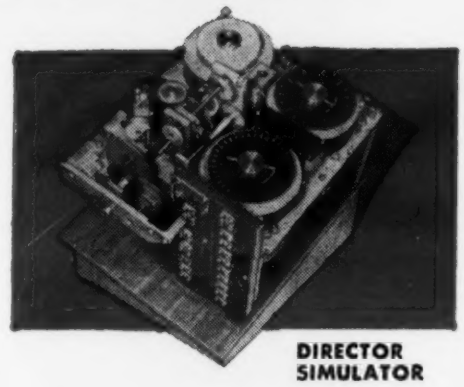
Let Daystrom Instrument assist you in meeting your product needs. One of our sales engineers is ready to discuss our qualifications with you. Write us, and he will call at your convenience.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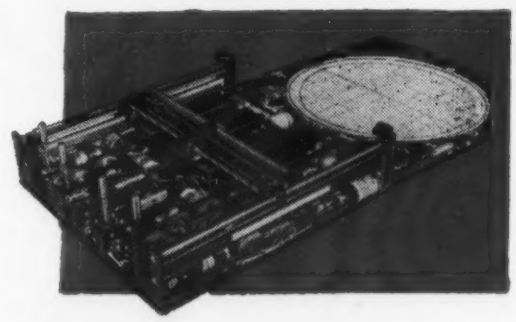
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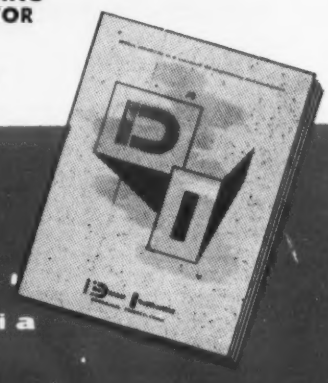

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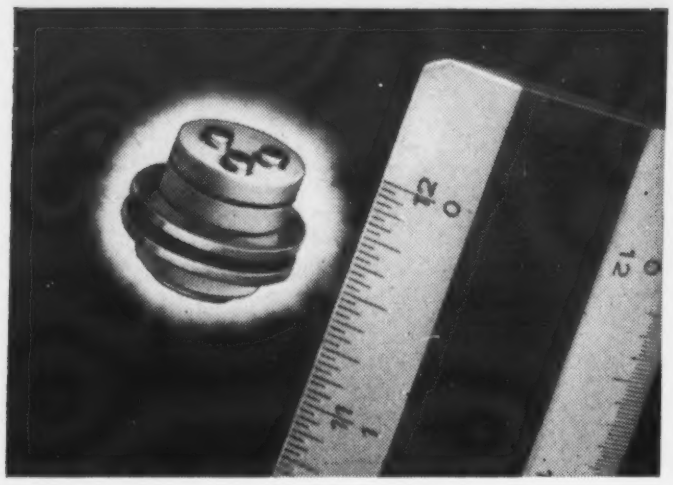
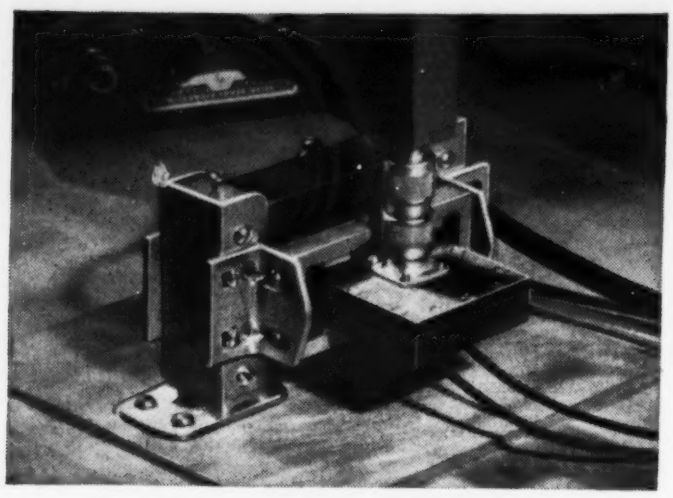
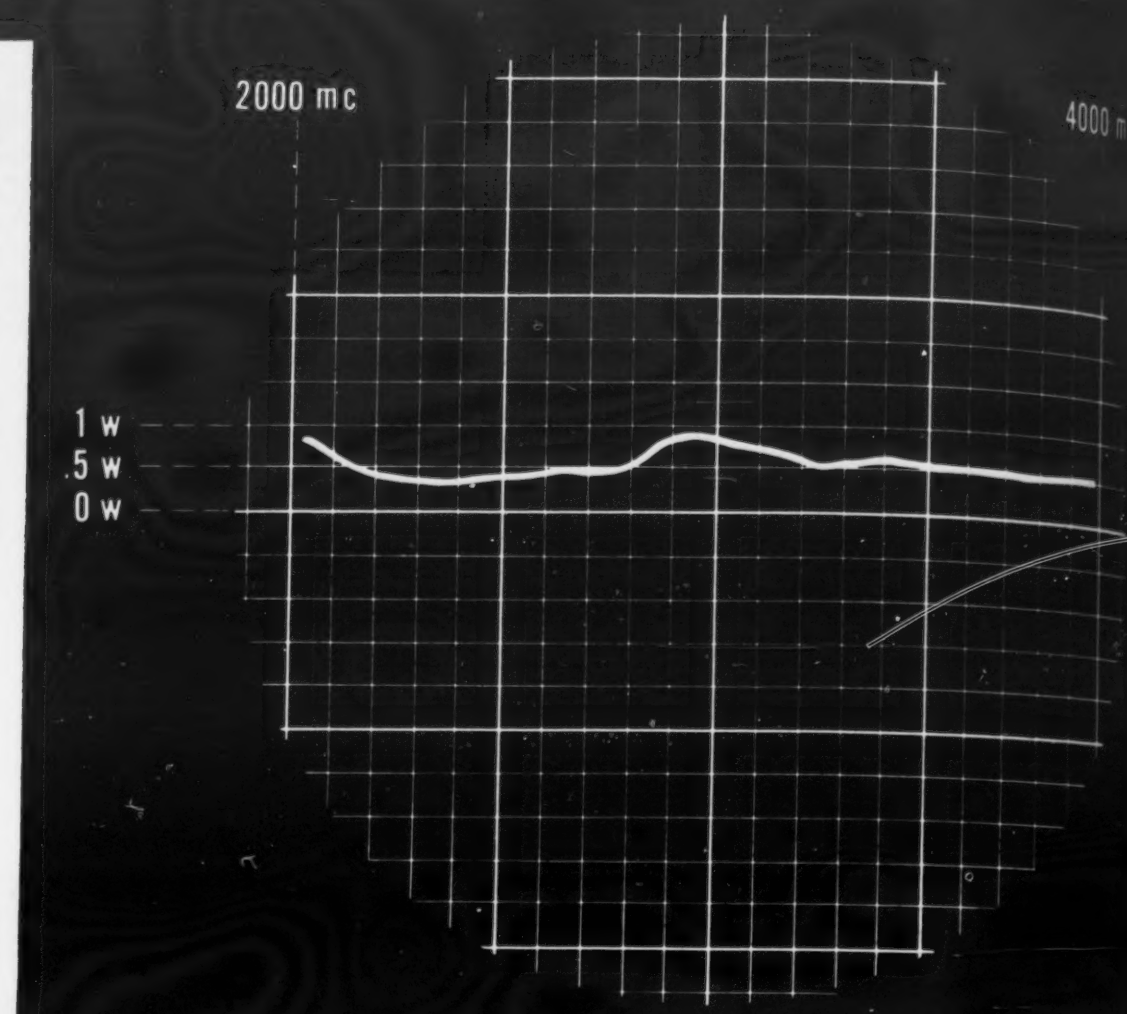


ABOVE: the GL-6917 voltage-tunable magnetron is extremely small and compact—only 5/8" high and less than 3/4" in diameter. **BELOW:** complete cavity and magnet assembly for the GL-6917 has been developed to assist equipment manufacturers.





▲ Observe from the scope presentation above (actual photograph made with a production GL-6917 on test) how power over the entire 2000-mc tuning range is substantially constant, varying only .5 w. Because tube frequency, with voltage-tunable magnetrons, is a linear function of anode voltage, an r-f signal can be tuned at will to any frequency in a wide spectrum.

New GL-6917 voltage-tunable magnetron combines wide-range tuning, steady output, dependability!

General Electric's GL-6917 voltage-tunable magnetron—first of a new series in development—offers to designers of military and other microwave equipment a simple, efficient means of changing output frequency rapidly with no important reduction in signal power.

The tube is a major breakthrough in circumventing enemy radar-jamming and in other counter-measure work. Also, the GL-6917 finds direct application in missile tracking and other telemetering . . . . . in air navigation . . . . . broadband test equipment . . . . microwave communications generally.

Construction is extra-rugged. Fundamentally compact and sturdy, the GL-6917 is a hard-solder type and is metal-ceramic for even greater strength. The tube is designed to operate unpressurized up to 60,000 feet altitude.

General Electric has developed a special cavity and magnet assembly for the GL-6917, to assist designers in applying the tube to equipment on the boards. For full information on Type GL-6917 and accessories, call your regional G-E power-tube representative! *Power Tube Department, General Electric Company, Schenectady 5, New York.*

Progress Is Our Most Important Product

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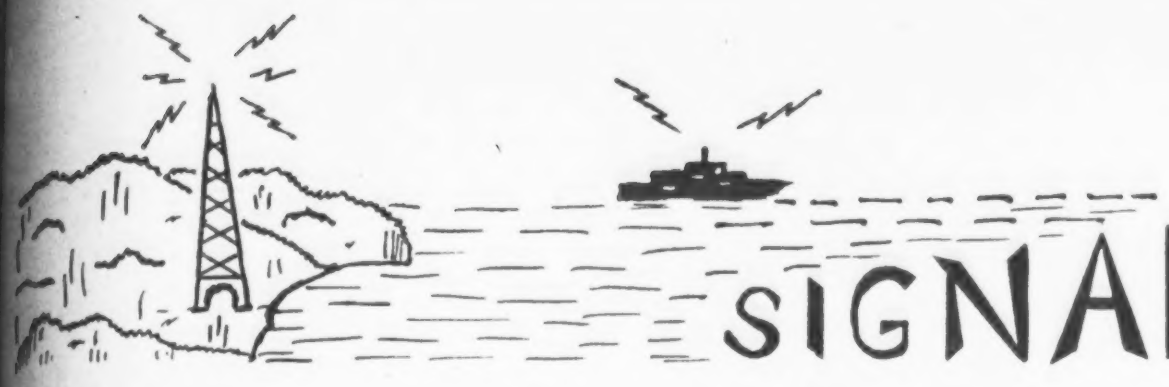

SIGNAL·GRAM

— GOVERNMENT —

"JETSTAR" SHINES America's first jet utility transport–the 10-passenger Lockheed Aircraft Corporation "JetStar"–successfully completed its maiden flight in September at Edwards Air Force Base, California. Setting a new record of 34 weeks from start of design to first flight, the 500-mph plane was developed specifically to meet Air Force requirements for a small, multi-purpose jet transport capable of performing a wide variety of missions economically.

AIR WEATHER SERVICE MOVES TO SCOTT AFB IN SPRING Headquarters, USAF, has directed that the Washington, D.C. headquarters of the world-wide Air Weather Service will move to Scott AFB, Illinois, during April, May and June of 1958. Other Air Force units involved in the move from Andrews AFB to Scott AFB are the Military Air Transport Service, headquarters of the Airways and Air Communications Service, and the 9th Weather group. Facilities vacated at Andrews AFB, just outside Washington, D.C., will be used by the Air Research and Development Command, currently located in Baltimore, Maryland.

AUTOMATIC PHONE SYSTEM What is believed to be the first electronically controlled automatic telephone exchange, eliminating the standard busy signal, has just begun operating at headquarters of British Telecommunications Research, Ltd., in London. The unit employs the "magnetic drum" storage technique and has an exceptionally high switching speed. If you call a number that is busy, you hang up and when the called number becomes free, exchange will automatically ring both calling and called subscribers. The work is jointly sponsored by Automatic Telephone and Electric Co., Ltd., and British Insulated Callenders Cables, Ltd.

RADIATION DETECTORS TESTED A new network of radiation detectors is being used in tanks, balloons and underground by Army scientists at the current Nevada atomic tests to measure the amount of radiation following an atomic explosion. Developed at the U.S. Army Signal Engineering Labs., Fort Monmouth, N. J., the new equipment keeps a continuous record of radiation hazards in the test area after a blast. The information is stored in well-protected underground recorders until the area can be entered safely. Results of these new tests may provide vital information on atomic battlefield tactics and for use by civil defense officials in planning against possible enemy nuclear attack.

CONTRACTS: ARMY: Hallamore Division, Siegler Corp., closed circuit television systems to monitor rocket engine and missile testing, $300,000; Republic Aviation Corp., combat surveillance systems with aerial drones capable of operating in any weather, $4,700,000; Philco Corp., radio relay units, $10,000,000; Electronics Corp. of America, infrared detecting sets, $487,657; Georgia Tech Research Institute, combat surveillance radar, $832,236; Dubrow Development Co., single sideband converters, $59,975; Admiral Corporation, receiver-transmitters for helicopters, $3,469,000. NAVY: General Electric Co., development of a handling and launching system for TALOS, $5,000,000; Radio Corporation ofAmerica, research and development study of an ultra-high-speed electronic computing system ("Project Lightning"), $1,500,000; Westinghouse Electric Corp., production of shipboard and aerial electronic equipment, $19,000,000; Federal Television Corp., airplane direction-finding equipment, $1,093,107; Cook Electric Company, design and construction of a completely mobile missile instrumentation and control system, $2,250,000; General Precision Lab., Inc., closed circuit TV system, $52,576. AIR FORCE: Fairchild Graphic Equipment, Inc., subsidiary of Fairchild Camera and Instrument Corporation, design and development of electronic printing rectifier, $246,000; Laboratory for Electronics, Inc., manufacture of APN/105, self-contained airborne Doppler radar navigation systems, $4,500,000; Sperry Gyroscope Company, production of "very advanced" airborne radar systems, $3,984,700; Boeing Airplane Company, quantity production of BOMARC ground-to-air guided missile, $139,315,000; Stromberg Carlson Co., central timing system, $114,548; International Business Machines Corp., SAGE data processing equipment, $2,723,916; Avco Manufacturing Corp., radar systems, $6,242,874.

"AMPLITRON" AIDS VITAL DEFENSE RADARS Development of a uniquely designed new electron tube, known as the "amplitron," that combines the best features of existing radar boosters and at the same time doubles their efficiency has been announced by the Army. The 10-pound tube is capable of boosting the energy output of a radar's basic signal by as much as 8 to 14 times. The tube, developed by the US Army Signal Engineering Laboratories and the Raytheon Manufacturing Company, makes possible lighter, more compact and versatile radar sets.

AERIAL GAS STATIONS ADVERTISE THEIR LOCATIONS Inflight refueling of Air Force planes anywhere in the world now is a routine operation largely because of an airborne "homing beacon" developed jointly by the Air Research and Development Command, Wright Air Development Center and Sperry Gyroscope Company. The high powered radar beacon makes it possible for fuel-hungry airplanes to rendezvous with flying tankers day or night, or in any kind of weather. The exact location of scheduled tanker planes can be pinpointed from hundreds of miles away.

— INDUSTRY —

CABLE FEE TV SYSTEM The nation's first cable theatre system went into test operation in Bartlesville, Oklahoma, in September. The system, called "Telemovies," is owned by Video Independent Theatres, Inc., of Oklahoma City. General Precision Laboratory engineered and equipped the studio origination aquipment. Telemovies ties a local theatre to home television sets via cable hookups. For a subscription of $9.50 a month, viewers will be able to see 30 movies a month, including 13 first-run movies. This system is not toll TV, but an experiment in merchandising to rejuvenate movie interest.

GROUND-AIR ROAD SHOW The M. P. Odell Company and General Precision Laboratory, Incorporated, have joined forces to present the first ground-air road show and exhibit in the electronics industry, featuring the introduction of the first aircraft to house a complete installation of closed-circuit TV for the demonstration of airborne television. The two-day ground phase of the demonstration, which is open to the public, will appear in five cities, including Cincinnati, Dayton, Cleveland, Detroit and Pittsburgh, between October 21 and November 7.

NON-EXCLUSIVE LICENSING CONTRACT FOR COMPUTERS Radio Corporation of America and International Business Machines Corporation recently signed a non-exclusive agreement exchanging licenses under their respective patents for electronic computers and other data-processing machines. Under the agreement, both RCA and IBM will have the right to use each other's patents in their electronic computers and other data-processing machines, and each company retains the right to license applicants under its own patents. In a joint statement, the presidents of the companies said: "This arrangement enables the widest possible competition between our companies without the risks of infringing each other's patents."

ELECTRONIC "BRAIN" TO JOIN TRAVELERS INSURANCE COMPANY Radio Corporation of America will install the nation's first commercial network installation of integrated electronic "brain" systems for the main office of the Travelers Insurance Company in Hartford, Connecticut. The network will contain four separate RCA Bizmac electronic data processing systems, which will be integrated through a unit, similar to a telephone exchange. The Travelers installation will represent the nation's largest integrated electronic data processing system under one roof. Installation will start early next year and the overall system is expected to be completed by 1963.

MARTIN COOLING METHOD The Martin Company, Baltimore, Md., recently disclosed an "evaporating cooling technique" which its thermal engineers called a "breakthrough" in the protection of electronic components, enhancing their reliability in both airplanes and missiles at speeds up to Mach 5 and temperatures up to 800 degrees F. The system would reduce the weight of a manned craft by 661 lbs. when traveling at Mach 3. Martin's modular concept is said to open up the possibility of remote location of the electronic equipment since the cooling system is self-contained.

ELECTRIC WRIST WATCH An electric wrist watch that recharges its own battery has been invented by Loren F. Jones, manager of RCA's business machine marketing department at Camden, N. J. His newly patented watch is run by an electric motor, powered by a tiny storage battery. The wearer's random wrist movements wind a small spring. The spring, when released from time to time, sends surges of current through the battery. According to the inventor, the battery should last for a number of years.

COLOR TV DEBUT IN CUBA The first color television station outside the United States will go on the air, using RCA equipment, on October 24 in Havana, Cuba. The station will be headed by Gaspar Pumarejo, a pioneer in black-and-white television in Cuba. Initial plans call for a twenty-hour long color program schedule each day built exclusively around films, repeating a basic two-hour film program ten times, and inserting fresh news and other items. Filmed news and other features will be flown to Havana daily from New York, Miami, Mexico City and Madrid.

(Continued on page

U. S. Army Photo

Experimental rocket being launched from tower at DOFL's Maryland test facility.

ELECTRONIC AMMUNITION THAT "THINKS" IS DEVELOPED AT ARMY'S DIAMOND ORDNANCE FUZE LABORATORIES

Since 1940, scientists and engineers at Diamond Ordnance Fuze Laboratories, with their industrial contractor counterparts, have made important contributions to electronic ordnance. These include the proximity fuze, greatly improved fuzes for antitank and other special ammunition, and, more recently, fuzing systems for guided missiles. Other basic results of DOFL's research and development teams are new electronic systems which increase the accuracy of measurement of distance, velocity and direction, new electronic and mechanical control systems, and new and radical components and materials. DOFL's main laboratory is in Washington, D. C., and it maintains an extensive test facility at Blossom Point, Maryland. Over 1400 scientists, engineers, technicians, and supporting personnel work in these centers.

Electronic ordnance was born in World War II. Ammunition of this type, a DOFL specialty, senses the presence, distance, and direction of a target and causes the warhead to function at the instant when it will inflict the most damage. Electronic control can be compared to having a sharpshooter in every piece of ammunition. The accurate effect is devastating.

Many advances in ruggedness and miniaturization, pioneered by DOFL, are contributing significantly to peacetime technology. Typical industrial products which sprang from ordnance programs are printed electronic circuits, tough and tiny electronic tubes, and rigid mounting of components in solid plastic blocks. These valuable by-products have contributed heavily to the ability of DOFL's industrial teammates to design safer, smaller, and better components.

This is one of a series of ads on the technical activities of the Department of Defense.

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DIVISION OF SPERRY RAND CORPORATION

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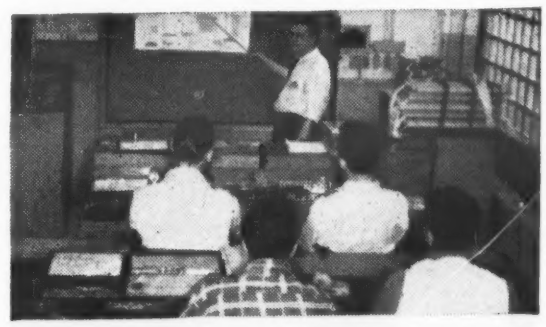

Class of technicians at Ford Instrument is instructed on techniques to be employed in assembling equipment for Army Ordnance project.

— GENERAL —

GOLFING ELECTRONICALLY While testifying at the FCC's 890mc hearings, Daniel E. Noble, a vice president of Motorola, Inc., outlined a possibility that would enable the duffer to sit back at the clubhouse and watch his perfect score flashed back. He said a motorized cart would carry radar, computers and servo-mechanisms so that it would be remotely controlled and follow the ball about the course. It could calculate the range, direction angle and velocity, complete the shot,and radio the result back to an automatic scoreboard. Mr. Noble was not advocating spectrum space for this nor does he recommend this for the present.

TALKING TO THE MOON United States Naval scientists of the Naval Research Laboratory in Washington, D. C., have announced that they have succeeded in using the moon as a radio relay station for round-trip transmission of voice messages. This scientific breakthrough, regarded as the most significant discovery made by radar, followed six years of experiments.

NEW ELECTRONIC "SEA HIGHWAYS" The first chains of the Bendix Decca Navigator system, installed by the Pacific Division of the Bendix Aviation Corporation on the North American continent, have been officially opened in Canada. The system, an American invention used for years in European waters, is a low frequency radio position-finding device that can be operated either automatically or manually to provide a continuous "map" of a ship's course and heading. The chains, covering an area of one million square miles, will form a navigational "key" to some of the most heavily traveled waters in the world--by transatlantic lines to private yachts.

NEW HELICOPTER SERVICE The first emergency shipment to be transported by helicopter left the Westinghouse East Pittsburgh plant's new rooftop heliport recently. The load was rushed to the Greater Pittsburgh airport for shipment aboard an airliner. The new helicopter service, which includes an eight-passenger vehicle, was inaugurated to provide fast emergency replacement parts service to customers. The "whirlybirds" can handle freight shipments up to 500 pounds.

ANALOG COMPUTING CENTER IN BELGIUM Belgian Minister of Foreign Trade, Henri Fayat, and C. L. Adamson, Vice President of Electronic Associates Inc., Long Branch, N. J., recently officially opened the U.S. firm's first overseas operation, the European Computation Center in Brussels. The Center is equipped with two expanded analog computer systems and provides education to engineers in analog computer techniques, consultation service and rental time on the Center's machinery.

HOW TYPHOONS ARE NAMED In the Pacific ocean, typhoons are identified by girls' names, as are their counterparts, the hurricanes, in the Atlantic ocean. Four sets of names are used in a continuous fixed sequence, without regard to the calendar year or season. The first typhoon in the Pacific during each season is assigned the name directly following the last name used during the previous season. When all 84 names have been used, the list is repeated, starting with "Alice," the first name in the first set.

DISCOVERY OF "HIGHER" SUN ENERGY A 3500 mile per hour Aerobee-Hi research rocket launched recently at Holloman Air Development Center, New Mexico, reached a new 120-mile record height for chemical ejection experiment vehicles. This gave "conclusive proof" to officials of the Air Force Cambridge Research Center's Geophysical Research Directorate that there is a reservoir of stored solar energy at much higher altitudes than previously believed possible. This discovery indicates the feasibility of developing rockets which will obtain their own propulsion energy from the stored sunlight around them.

CONVENTION CALENDAR HIGHLIGHTS

OCTOBER 24-25–The Fourth Annual Computer Applications Symposium, sponsored by Armour Research Foundation, will be held in the Morrison Hotel, Chicago. New computers and applications, and advances in automatic coding will be stressed in invited papers, panel sessions and discussion.

OCTOBER 28-30–"Electronics in the Jet Air Age" will be the theme of the Fourth Annual East Coast Conference on Aeronautical and Navigational Electronics held by the IRE at the Fifth Regiment Armory, Baltimore, Maryland.

NOVEMBER 11-13–EIA is sponsoring its Radio Fall Meeting at the King Edward Hotel in Toronto, Canada. 500 top engineers and managers in the entertainment, radio and television fields are expected to attend.

NOVEMBER 11-13–Recognizing the growing importance of the South in the electronics industry, the Third Annual IRE Instrumentation Conference will be held in Atlanta, Georgia. The conference theme will be "Instrumentation for Data Handling."

NOVEMBER 13-15–The American Standards Association will sponsor their Eighth National Conference on Standards at the St. Francis Hotel in San Francisco, California. Eleven sessions are planned, including more than 50 speakers.

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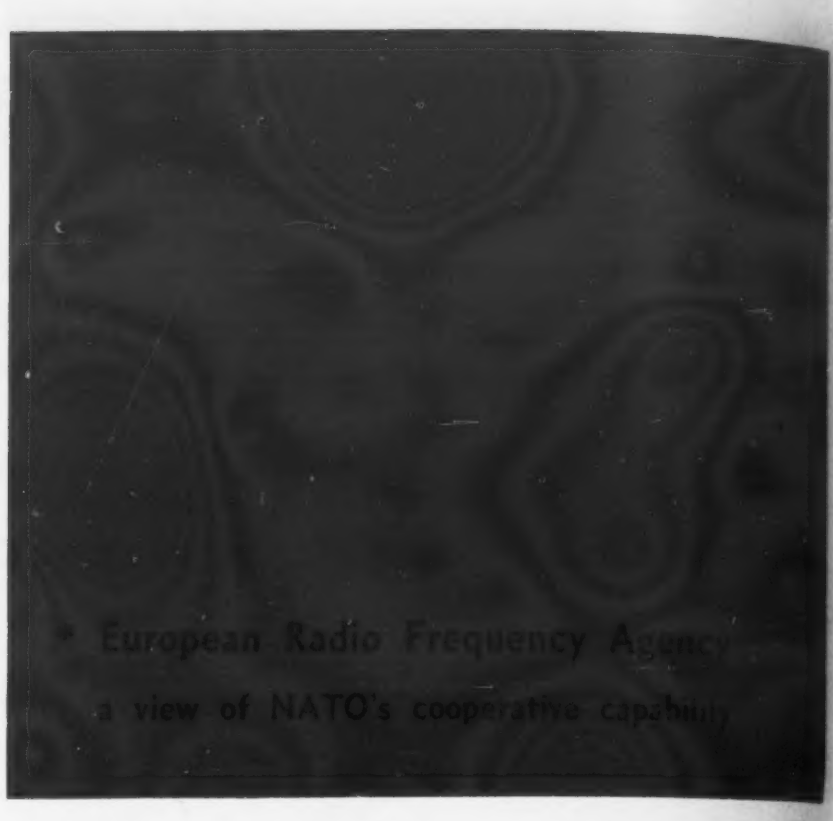
ERFA *

by Major B. W. Filipski, USAF
Air Command & Staff College
Maxwell A.F.B., Alabama



THE ORGANIZATION OF ERFA (EUROPEAN RADIO Frequency Agency), a cooperative venture of the North Atlantic Treaty nations of Europe, was born of necessity to pool effectively a vital resource differing greatly from earth commodities such as coal or iron. This common world resource is radio frequency spectrum which, to the non-technical and uninitiated, is as free as air with no marketable assets, but which, in reality, is a critically vital resource of all nations.

Several factors distinguish radio spectrum from previously known types of resources and serve as background for discussing ERFA. (1) Various portions of the radio spectrum have radically different propagation characteristics. A portion effective for night transmission may be useless for daytime use; those ideal for the North may be worthless for tropical communications. (2) In spite of the "oneness" of this world resource, each nation has sovereign rights to the entire spectrum. (3) Once a transmission encroaches upon another nation's use of that same frequency, equitable adjustments must be made. The sovereign nations belong to the International Tele-communications Union (ITU), which establishes rules and regulations governing radio frequency allocations and regulation of frequency assignments. (4) World War II presented new problems for the ITU, due to progress in telecommunications and electronics together with the expansion of civil and military air capacity. In 1947, the ITU agreed to allocations of exclusive bands for aeronautical services. Portions of the bands allocated to other services consequently had to be compressed. Meanwhile, nations engaged in post-war economic resurgence, defense commitments, and future expansion planning were dependent upon more radio communications and consequently were requiring expansion in those very portions already compressed. (5) An international accounting system became a necessity. The ITU devised a plan whereby radio assignments conforming with Radio Regulations would be recorded by the International Frequency Registration Board.

These, then, are the general limitations of the radio frequency spectrum and the purpose for the international control body, the ITU.

Two years after the North Atlantic Treaty was signed, the NATO nations moved for the creation of a military shield. General of the Armies Dwight D. Eisenhower, Supreme Allied Commander in Europe (SACEUR), arrived in Paris, January 1951, and created the Supreme Headquarters Allied Powers, Europe (SHAPE). The Standing Group, NATO's top policy making body, established ERFA to serve SACEUR in negotiating for and managing radio frequencies. SHAPE'S area of responsibility extends from Norway's North Cape to the Caucasus in Eastern Turkey. Within this area are 12 member nations of NATO, each exercising authority over the radio spectrum. SHAPE, itself, became another competing "nation" for portions of the already overcrowded spectrum. Thus, ERFA provided the vehicle for close coordination with non-military frequency control bodies of NATO together with other international and national military commands within SACEUR's area of responsibility.

ERFA prepares and maintains technical arrangements for coordination of radio frequencies, advises nations when civil circuits may adversely affect military circuits, and recommends alternate frequencies by consulting a consolidated up-to-date list of current radio frequency assignments of NATO nations and European military commands.

The Agency is composed of a Committee and a Radio Frequency Bureau. The Committee has military representatives from each NATO country, one from SHAPE, and a Chairman and Secretary in an international capacity. The Radio Frequency Bureau is an international secretariat composed of radio engineers, translators, together with security, secretarial and administrative personnel. Directed by the Chairman, it carries out decisions made by the Committee.

Master Radio Frequency List

Vitally necessary to ERFA was the procurement of radio frequency records from all NATO nations. Schooled in practicality, the smaller nations were reluctant to give up this valuable data without safeguards and evidence of equitable cooperation. The Chairman's preparation of a method of checks and balances acceptable to the entire Committee is regarded as one of ERFA's most significant accomplishments. Today, the Master Radio Frequency List of ERFA numbers over 150,000 up-to-date entries—the world's second largest international list.

In February 1953, a combination of hurricane winds

(*Continued on page* 32)

How RCA tracking equipment will escort first man-made moon into its orbit

"Ten . . . nine . . . eight . . . seven . . . six . . ."

At the launching site, and for 2,000 miles down range, RCA men stand by U. S. Air Force equipment, listening to the countdown.

In seconds — just five now — their tracking data will begin to pour like a flash flood into the Central Control room at the Air Force Missile Center. And the first man-made moon in all history will be rocketing toward its orbit in outer space.

Rocket speed, position, angle of climb, course, and much, much more must all be resolved into one vital decision by the men in Central Control:

Whether and when—to the split second — to trigger a ground command that can aim the satellite into its orbit or, if necessary, destroy it.

The tracking data will come from the most ingenious and accurate instruments it is now possible to devise. From start to finish they have been planned, engineered, installed, maintained and operated by RCA.

In helping bring man to the threshold of The Space Age, RCA helps fulfill the promise of untold benefit to people the world over — and proves again that there is real meaning in the slogan—*"RCA—Electronics for Living."*

RADIO CORPORATION OF AMERICA
"ELECTRONICS FOR LIVING"

project FOUR WHEELS

Signal Staff Report

LIGHTWEIGHT, COMPACT, mobile air traffic control towers and communications facilities that can be flown into disaster areas or forward air strips and quickly put into operation are now being delivered to the Air Force by Craig Systems, Incorporated, Danvers, Massachusetts. The over-all system, called Project "Four-Wheels," is composed of a series of individual self-contained facilities and is designed to provide the military with improved tactical and fixed air traffic control and base communications facilities. This communication-air navigation unit is capable of performing a squadron's mission in the space of a house trailer, with the mobility of a field command post.

The project was sponsored and developed by AACS (Airways and Air Communications Service) in Rome Air Development Center in conjunction with Craig Systems, Incorporated, prime contractor. This requirement for a mobile communications system was recognized by AACS during support of the Korean operation. Now AACS in Europe has passed another milestone in its long and colorful history. Project "Four-Wheels" became a reality on the European Continent and will soon be ready for deployment in support of maneuvers, exercises or emergencies.

Means for Mobility

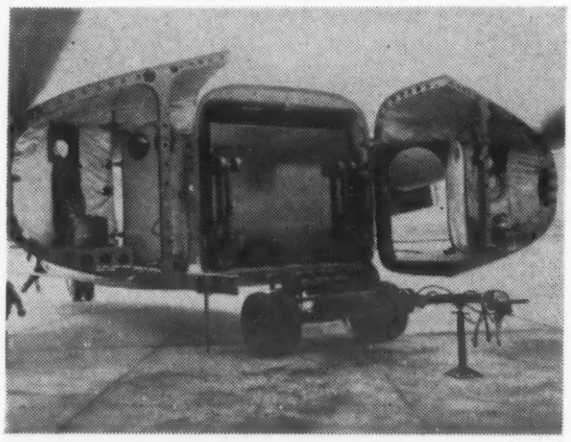
The required mobility is obtained through the installation of selected items of communications and Navaids equipment in trailer vans which can perform the same functions as a permanent airport installation with the strategic advantage of being easily towed or flown by C-119 or other cargo aircraft to forward areas and quickly put into operation. To satisfy the mobility, air lift and shock isolation requirements for the amount of equipment involved, a special lightweight, insulated trailer was developed by Craig.

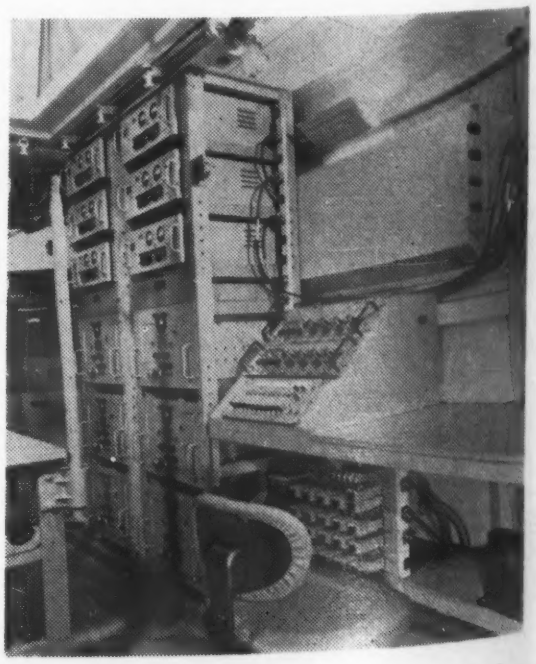
Features of the van trailer include a detachable undercarriage for aircraft loading with a four-wheel, single-axle, coil spring shock absorbing suspension system. For equipment reliability, a special interior shock isolation frame was devised. The components of the project include a control tower, radio beacon, radio transmitting and receiving equipment, a communications center and power units. Considerable human engineering was designed into the individual facilities to provide for the most efficient layout of components and reduce operator fatigue. These facilities are capable of being operational in one hour from delivery to a forward base by a crew of four men.

Component Characteristics

One important feature of the units is the self-contained combination air conditioner, heater, and dehumidifier which has a collective protector to remove atomic, biological and chemical contamination from the air.

All of the units, measuring 13 feet long, eight feet wide and seven feet high, are so designed that they can





LEFT . . . mobile control tower which performs same function as permanent airport installation. ABOVE . . . one step in loading Van V-83/M into C-119 aircraft. RIGHT . . . interior of control central AN/MRN-12.

be used independently in any combination so as to provide either complete airport facilities or any part that may be required.

Air Traffic Control Central, designated the AN/MRN-12, is a prefabricated control tower consisting of a van with a retractable tinted glass dome. The observation dome is fitted with special glass panels to prevent fogging and icing to give the operator 360-degree visibility. The AN/MRN-12 provides three Very High Frequency (VHF) receive-transmit channels, three Ultra High Frequency (UHF) receive-transmit channels, one High Frequency (HF) receive channel, one Low Frequency (LF) receive channel, visual signaling equipment, wind and altimeter equipment and two operation positions with terminal equipment for telephone and local wire communications.

At the operator's finger tips is a console with instruments to give him radio communications with aircraft taking off and landing, as well as with base operational facilities. A second position holds approach control equipment and the CGA operator, when off the air, can act as switchboard operator for incoming calls.

Other equipment includes a low frequency radio beacon designed for continuous operation from a mobile site. It provides speech amplifiers for beacon operation and voice transmission. A radio transmitting set is designed to complement the receiving sets which together support the Central Office-Teletypewriter, by providing medium range, point-to-point and ground to air communications.

Source of Energy

Power for all of this equipment is provided by 10KW generators mounted on two-wheel, 1½ ton trailer chassis of a new design. Each piece of mobile equipment uses two generators, one for primary power and the other as stand-by.

The Four-Wheels equipment now provides the military with communications and navigation facilities in completely packaged form that is readily adaptable for lengthy storage or for prepositioning at air bases and capable of rapid activation without further requirements for additional components or equipment. The arrival of Four-Wheels equipment in Europe, enables the AACS to fully support USAF and NATO Air Forces in any location and on extremely short notice.

EVERYBODY looks up to

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Leading Worldwide Supplier of Parabolic Antenna Systems for Communication Services

There's much to be gained by using a Prodelin Parabolic Antenna . . . whether your application is for line-of-sight, point-to-point microwave communication, or for over-the-horizon tropospheric scatter service for long distance communications.

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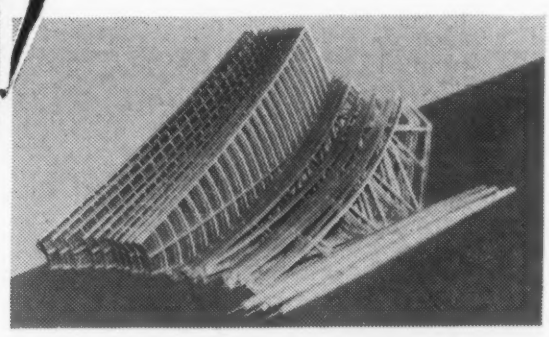
Prodelin manufactures field proved parabolic reflectors with associated feeds providing the most complete antenna line in 2, 4, 6, 8, 10, 14, 18, and 28 foot diameters for every type of communication requirement.

If there is not a stock Prodelin antenna to suit your specific needs, Prodelin will design one for you. In active service throughout the world are rugged Prodelin aluminum mesh antennas that withstand 150 mph windloads fully iced . . . economical spun aluminum reflectors for similar services . . . and the new sectionalized plastic reflectors . . . all designed for low cost, long distance transportation by land, sea, or air. Remember, a Prodelin antenna costs *less* than any other part of your system . . . and with *larger* antennas, you can achieve greater gains at lower maintenance costs!

No wonder everybody looks up to Prodelin . . . it's head-and-shoulders above the crowd.

28 ft. Tropospheric Scatter Antenna



28 ft. antenna knocked down for air freight shipment

Write today! Get complete technical information on Prodelin Parabolic Antenna Systems including associated transmission lines and other RF network devices all terminating with industry's latest RETMA standard fittings.

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LESSONS | FROM | SIGNAL | CORPS | HISTORY

a book review

by Dr. George P. Bush, Emeritus Professor, American University

MANY READERS WILL RECALL that the first volume of the official history of the Signal Corps in World War II, *The Emergency*, by Dulany Terrett, was concerned with events which transpired between the world wars, concluding on the theme of Pearl Harbor. This second volume, *The Test*, begins with Pearl Harbor and is concerned with the dramatic events of the next eighteen months. The third volume, now in preparation, will conclude the story. This history is one in the series entitled *United States Army In World War II*, a series which is under the general editorial supervision of the Office of the Chief of Military History, Department of the Army.

Comprehensiveness is a relative matter. One may take a comprehensive look at Signal Corps training activities or at any of the other many facets of Signal Corps activity. Or, one may look beyond to take a comprehensive view of the total Signal Corps effort. Or looking still further, one may see the technical services in their several relationships. Thus it is with the present volume that we are able to get a clear and comprehensive picture of what the Signal Corps did during a particular critical period. Moreover, it gives us many of the overtones and innuendos which are all a part of the life of both men and organizations. One reads *The Test* as though there were unfolding before him for the first time the *reasons* which underlay so many of the intricate activities of this involved period of eighteen months of World War II, when so much was at stake.

With Value Judgments

The four authors deserve great credit for the skill manifested in their endeavors to portray interestingly and factually the events of the period and to bring out their meaning and importance. The authors are George Raynor Thompson, Dixie R. Harris, Pauline M. Oakes and Dulany Terrett. Their source material was voluminous and much of it expressed in language that was official and highly technical. This reviewer is particularly pleased with the candid expression of value judgments so soon after the events which gave rise to them.

Examining the book more specifically, one notes that it is chronological in treatment. In fact, each of the sixteen chapters covers both a topic and a stated time period. Three principal topics are covered: research and development, training and supply, together with their many interrelationships being woven in and out of the several chapters. In addition, there is a chapter on Alaska communications, one on photographic activities, one on global communications and two on the North African field situation.

The authors have cleverly brought out the drama which lay behind certain factual reports. Beginning with the first chapter, even the first sentence, one sees the drama of Pearl Harbor in its earliest stages. From those first words, "At four o'clock on the morning of 7 December 1941, . . ." and on through the book to the last chapter which depicts an organizational crisis, there is drama for those who either read it straight or those who read between the lines. This history is alive. Here is depicted a relatively small technical service, charged with very important responsibilities to the whole army, starved over the years for the funds with which to do an adequate job, suddenly burgeoning outward and upward like a small A-bomb blast. The statistics scarcely tell the story properly. During these critical eighteen months, the officers increased from 3,000 to 27,000 while the enlisted men went from 48,000 to 287,000. At the same time, other Signal Corps activities were growing at an equal tempo. During June 1942, the Signal Corps "was accepting every two weeks as much signal equipment as the amount procured during the entire course of World War I." It is difficult to realize that such a tempo was reached only seven months after Pearl Harbor.

Reserach and development activities were vital to the improvement of signal comunications. Signal Corps engineers brought forth a constant stream of better radio, radar, telephonic, telegraphic, photo and other technical equipment to meet the Army's world-wide needs. In particular, frequency-modulated (FM) radio sets were refined and mounted in the tanks to give Armor better communications and a revitalized role of action. Airborne radar flourished in this period and was particularly useful in air-to-surface vessel use. Gun-laying radar (the SCR-584) was another 1942 achievement of great usefulness to troops. In the telephonic area, wires and cables were improved along with circuit and terminal equipment.

Lesson in Administration

The dual responsibility of the Signal Corps is brought out in various ways. Not only is it a supply and technical service, but it is also a combat arm, training and furnishing troops. In this respect, it resembles the Corps of Engineers. This duality of function increases the contacts with higher command and thus causes liaison to be more difficult. The Chief Signal Officer's "public relations" thus became very important to him and required great skill in satisfying the demands made by many superiors. For example, General Somervell, the Chief of Army Service Forces, took over in March 1943 the seven supply services (including the Signal Corps) and a year later announced that henceforth they would be known as the technical services. The contacts between General Olmstead and General Somervell were never harmonious and deteriorated rapidly in early 1943. By June 1943, General Olmstead had retired. A careful reading of this episode as recorded in Chapter XVI can be a potent lesson in administration, par-

Signal Corps (Cont.)

ticularly as related to such principles as organizational structure, delegation of authority and responsibility, unity of command, and, particularly, a continuous reconsideration of all matters pertaining to the organization as a part of regular operations.

A very significant sentence appears on page 23: "But M Day had remained unidentified, and the events of war now differed from the plans." So it always is from war to war. The best laid plans fail to match the new situation. The answer lies not in foregoing the planning function, but rather in improving it. And improvement can be made, in part at least, by a careful evaluation of the book which is under review and others like it. *The Test* abounds with the lessons of Signal Corps history. Many of these lessons were caused either by ignorance of certain basic principles or by forgetfulness or complacency. It is here that history can be a constant reminder—not that history will repeat itself, but that basic principles tend to endure. An analogy is found in the case of the *Report of the Chief Signal Officer* (1919), a 547-page document published about one year subsequent to the armistice of World War I. This report was, in effect, the Signal Corps "history" of World War I. Such as it was, this document served in a variety of ways to point constantly to the truism that "The Past is Prologue."

It is in this respect that those presently in the Signal Corps are in debt to the authors of *The Test.* No one knows how timely the publishing of such a history may be. Here is a book of great potential usefulness as well as of readable current interest.

Copies of *The Signal Corps: The Test* (1957) and of *The Signal Corps: The Emergency* (1956) may be ordered by members of AFCEA at a special price of $4.05 and $3.15, respectively, through the Book Service, AFCEA, 1624 Eye St., N.W., Washington, D. C., or directly from the Superintendent of Documents, U.S. Government Printing Office, Washington, D. C., at $4.50 and $3.50, respectively.

ERFA (Continued from page 26)

and full moon tides smashed the dikes of Holland. With waves tearing 40 miles inland, an old enemy was cloaking one sixth of the nation with disaster. NATO military forces were dispatched for assistance and immediately, ERFA was requested to furnish necessary radio frequencies for the required communications. Acting under agreed plans, ERFA selected frequencies from the List which provided the most effective channels of communication. Prior users were notified and ceased their operations in favor of those required in Holland. Isolated areas were soon connected by radio communications links so that rescue and rehabilitation work proceeded with great speed. Thus, ERFA provided another proof of NATO's cooperative capability for a non-military purpose.

By June 1953, this Agency of NATO was gaining strength, flexibility and striking mobility. New responsibilities were handed to its competent Chairman and representatives. Almost on the heels of the transfer to ERFA of the problems involved in Very High Frequency (VHF) assignments, another allied problem was demanding attention. Ultra High Frequency (UHF) was gaining recognition by naval, land and air forces as a valuable new portion of the spectrum. Necessarily, the problems of UHF allocations and assignments also devolved on ERFA. After the forming of a VHF/UHF Panel, an allocation plan was eventually drawn up for dividing the UHF band between the three services. But even more outstanding was the agreement to permit ERFA's Radio Frequency Bureau to act as the central control for coordinating, recording and recommending common engineering criteria in the UHF band for 15 nations.

In the success of a cooperative venture, leadership is often taken for granted. The Committee's accomplishments were the result of combining 15 competent, individualistic and nationally proud representatives whose subordination to a common purpose and technical competence enabled them to stimulate cooperative reaction in the Agency to fit the international situation.

Without doubt, ERFA has contributed to the cohesive strength of NATO. Cooperative control of the radio spectrum became a supplement to sovereign control within NATO. An example of effective management and provisioning, ERFA is tangible evidence of obtainable success in international cooperation.

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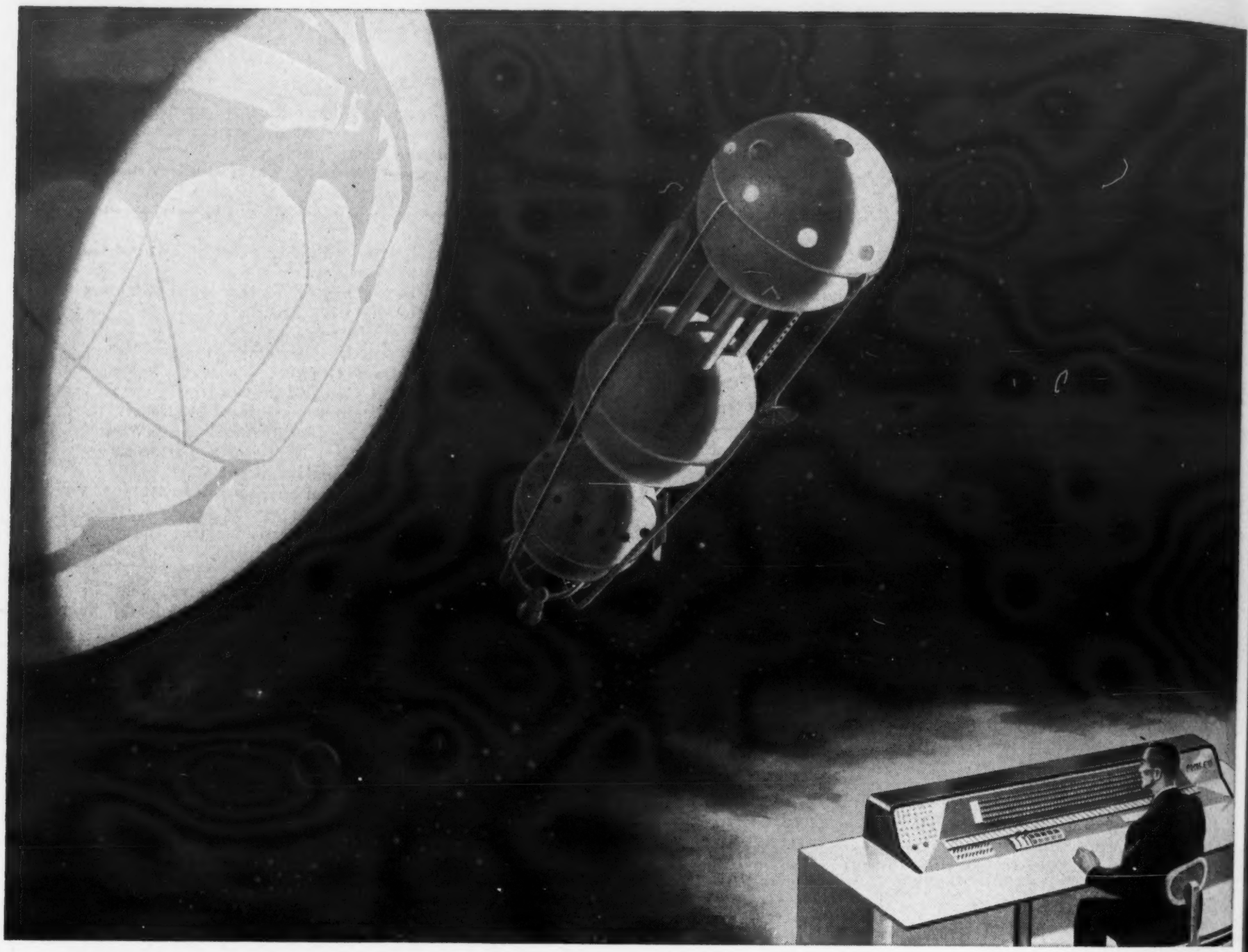

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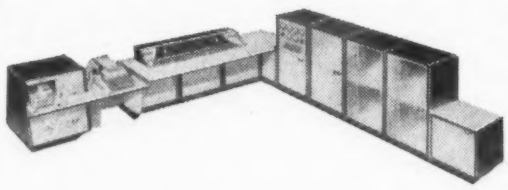

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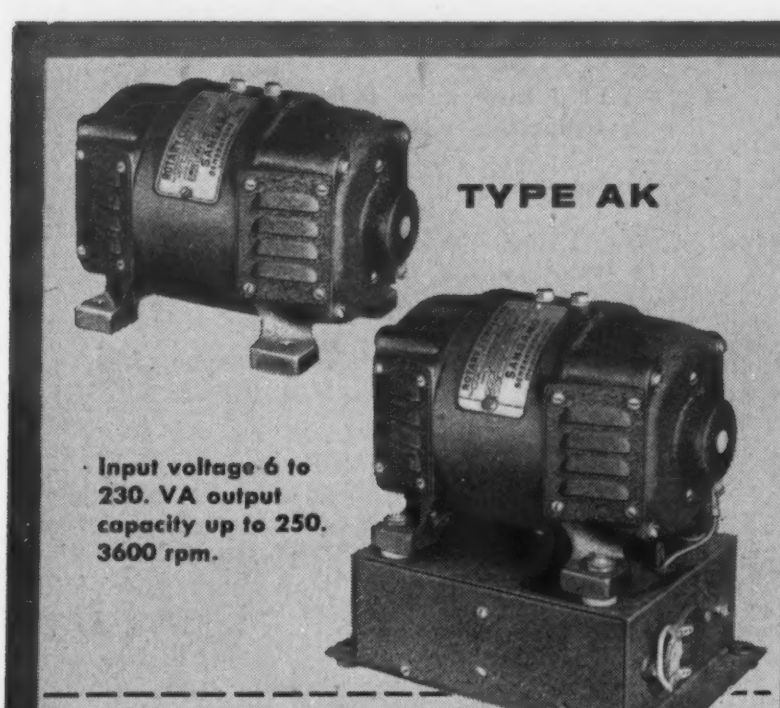

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The modern accelerated production techniques used in Sangamo's new "controlled conditions" factory in Pickens, South Carolina aid in fulfilling all delivery schedules. This new plant is equipped for full capacity production of Rotary Converters, Dynamotors. Generators, and Special DC Motors. Specify Sangamo for *dependable* units and *dependable* delivery.

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SG57-4

Chapter News

Atlanta

The chapter's schedule of meetings has been set up as follows: September 24, November 19, January 21, March 18 and May 13.

These dinner-meetings will be held at the Fort McPherson Officers' Club. Any AFCEA members from other areas who will be in Atlanta on any of the above dates are welcome to attend.

Baltimore

A program on shipboard guided missiles, conducted by Capt. Leslie M. Slack, U. S. Navy, Bureau of Ordnance, Navy Systems Director, Surface Weapons Systems, was scheduled for the chapter's opening meeting of the fall season on September 17th.

Dayton-Wright

The chapter has instituted the office of executive vice president to facilitate administration of its affairs, with Col. J. B. Rippere appointed to this post for 1957-58.

The following have been named to the board of directors: Lt. Col. W. D. Jones; M. O. Davis, Dayton Air Force Depot; William Klein, Gruen Watch Co.; L. D. Sullivan, General Electric Co.; George Meyer, Westinghouse Electric Corp.; Col. Forrest G. Allen, Hqrs. ARDC; Willis K. Sutton, Summers Gyroscope Co.; Walter Bass; R. J. McIlrath, Raytheon Manufacturing Co.; Lt. Col. G. R. Kraus; Byron K. Boettcher, Avco Manufacturing Corp., Crosley Div.; H. C. Blackburn, Sylvania Electric Products, Inc.; Paul Clark, RCA; Harold Hollister.

Fort Monmouth

Halsey F. Hubbard of the U. S. Army Signal Equipment Support Agency has succeeded to the presidency of the chapter due to the transfer of Col. Robert B. Tomlinson. Other officer appointments have been made as follows: first vice president—Col. Alvin L. Burke, to replace Mr. Hubbard; treasurer—Margaret Manuel, USASESA, to replace Esther Ipri who resigned.

Committee chairmen for the various phases of chapter activity have also been designated for the current year. They are: membership—Col. Robert P. Haffa, USASEL; meetings—William J. Laverick, USASEL; industrial relations—Dr. Robert Meijer, Bendix Aviation Corp., Red Bank Div.; reserve affairs—Lt. Col. John E. Jenista, USASESA; public relations—J. Peter Hoffman, Office of Technical Information, Fort Monmouth; financial—George Trad, Trad Electronics Corp.; reception—Thomas Schlitz, TSS.

In addition, a new committee has been set up for the development of scientific manpower, with Arthur Adamson of Electronics Associates, Inc., as its chairman.

The chapter has inaugurated a monthly news letter, known as the "AFCEA Orbit," which will be sent to the members of the Fort Monmouth Chapter and other interested persons. Its purpose will be to "promote friendship and good will among the members" and to carry items of general and chapter interest.

San Francisco—Rear Admiral Frederick R. Furth, USN (Ret.), National President of the AFCEA, is shown addressing the San Francisco Chapter. At the head table, left to right are: C. L. Wickstrom of the Pacific Telephone and Telegraph Company and a past president of the Chapter; Admiral Furth; Commander S. N. Barton, president of the Chapter; Admiral Logan McKee, Inspector General, Bureau of Ships, and Admiral H. E. Haven, USN (Ret.).

New York

A dinner-meeting at the New York Naval Shipyard on September 18th marked the resumption of chapter activities after the summer recess.

Report of the meeting, which included a tour of the shipyard's material laboratories, will appear in the next issue.

Pittsburgh

The chapter opened its fall season on September 19th with its traditional picnic-outing. Held at North Park Lodge, the members and guests enjoyed the recreational facilities of the park, which included golf and fishing, and a fried chicken dinner. An added attraction was the distribution of door prizes.

Rocky Mountain

A picnic on August 17th highlighted the chapter's summer activity. Members and their families, chalking up an attendance of 125, enjoyed the customary picnic fare and an all-day program of events scheduled for all age groups. By its success, the picnic was established as an annual event.

San Francisco

Admiral F. R. Furth, National President of the AFCEA, was guest of honor at an informal dinner party given at the Fort Scott Officers' Club in San Francisco on August 12th. Some fifty members and guests were present.

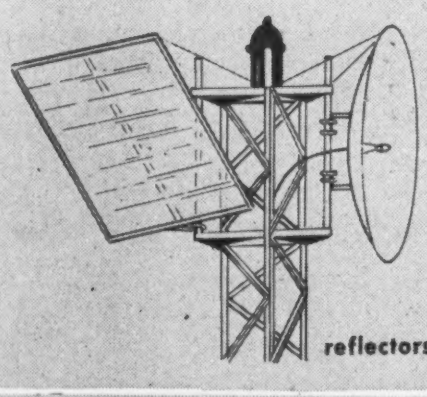
Special guests of the chapter were Adm. Logan McKee, Inspector General, Bureau of Ships, and Adm. H. E. Haven, USN (Ret.). Also present was Capt. W. B. Goulett, USN (Ret.), new Executive Vice President of the Association.

President Furth reported on the current status of the association and reviewed plans for its further growth in size and influence. He also conducted a question and answer session on local chapter problems.

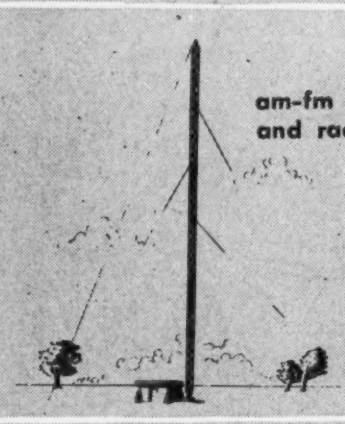
Scott-St.Louis

In answer to requests for a summer activity, the chapter arranged an excursion on the Mississippi River aboard the S. S. Admiral on August 17th. Members and their families boarded the boat at St. Louis and enjoyed an after-

In Microwave Towers and Reflectors . . . . .

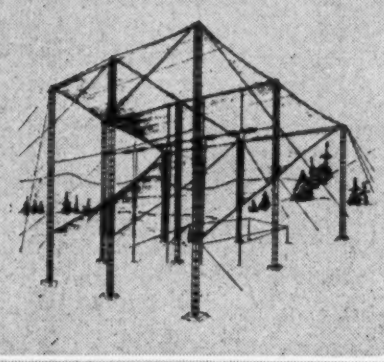


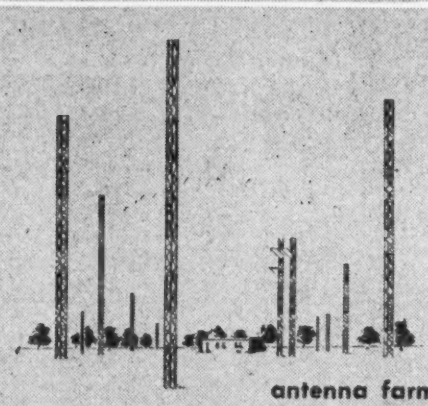
reflectors



am-fm towers and radiators

high gain corner reflector antennas





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Philco Corp.
Radio Corporation of America
Raytheon
Western Electric
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Michigan Bell (SAGE project)
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noon filled with entertainment. Facilities of the boat included a carnival and a Kiddieland.

South Carolina

At a meeting of the Board of Directors on August 22nd, committee appointments were made and the vacancy in the office of first vice president was filled.

The committee chairmen are: membership—William Schachte, Charleston Naval Shipyard; program and publicity—William F. Reilly, Charleston Naval Shipyard; finance—J. E. Butterworth, Southern Bell Telephone and Telegraph Co.

William O. Kiger, Southern Bell Telephone and Telegraph Co., was elected first vice president to succeed W. Thomas Edwards who had been transferred. Mr. Kiger and Col. Hubert N. Sturdivant, second vice president, were named chapter representatives on the National Council.

Program plans were discussed for the year, and September 19th was scheduled for the opening meeting.

Tinker-Oklahoma City

The dates of the 1957-58 series of meetings have been set as follows: September 19, October 17, November 14, December 13, January 16, February 20, March 20, April 17 and May 22.

The committee making the arrangements for the year's programs consists of John Mercer, Lt. Col. Richard F. Amann, William A. Kitchen and Hal Doolittle.

New Group Members

The AFCEA has recently welcomed two new group members, Federal Telecommunication Laboratories, Division of West Coast Laboratories, San Fernando, California, and Autonetics, Division of North American Aviation, Inc., Downey, California.

Federal Telecommunication Labs., which deals in electronic research and development, has named the following company representatives in AFCEA: P. R. Adams, Director, West Coast Labs; R. T. Cowden, Director, Customer Relations; J. E. Bower, Administrative Manager; C. T. Clark, Senior Member, Technical Staff; W. S. Chaskin, Director, Wire Communications Lab.

Autonetics, which is concerned primarily with the research, development and manufacture of electromechanical products, has named the following company representatives in AFCEA: S. W. Horrocks, Ass't. General Manager; R. M. Ashby, Chief Engineer; N. F. Parker, Ass't. Chief Engineer; B. P. DuMars, Manager, Contracts & Proposals; J. Emmi, Factory Manager; D. G. Soergel, Applications Manager; M. H. Suggs, Director, Quality Control; C. R. Raftery Material Director; D. S. Grant, Customer Relations Coordinator; K. Anderson, Director, Public Relations.

CONTRAVES ITALIANA S. p. A.

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GUIDED MISSILES

ANALOG COMPUTERS

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MEASURING INSTRUMENTS

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ITEMS OF INTEREST

From Government, Industry and the Services

Bell's Pocket Receiver

The Bell Telephone Company of Pennsylvania is experimenting with a personal signaling service, described as somewhat of an extension to the conventional telephone bell.

Utilizing a small, transistorized radio-receiving set, the system is tuned to a fixed frequency and operates over a range of a few miles. When clipped to a belt or inside of a pocket, the receiver is capable of informing a person of an important message at his home or office.

When the message arrives at an office, the signaling operator is contacted and she "dials" the number of the desired receiver. Voice-frequency pulses go out over the radio channel to activate four reeds in the set. The reeds trigger an oscillator and a tone sounds, alerting the person.

The system in the test area of Allentown-Bethlehem is capable of handling about 3000 customers. The sets are rented.

Nuclear Power For Missiles

The use of nuclear power to propel missiles of the future is under serious investigation by Lockheed Missile Systems division scientists.

The nuclear propulsion studies will be further advanced with a powerful new atom smasher, which has gone into use at the Lockheed nuclear laboratory. This is one of the facilities of the missile division's research and development center located in Stanford University's Industrial Park at Palo Alto, Calif.

The three-million-volt Van de Graaff positive ion accelerator is the largest such device in use within the aircraft industry and the first of its type on the West coast.

Dr. R. D. Moffat, who will be in charge of the machine's operation, explained that it can produce nuclear radiation under controlled conditions which permit great accuracy of measurement.

He said that the ion beam emerging from the accelerating tube consists of high velocity hydrogen or helium nuclei which interact with the atomic nuclei of the target material. These processes will be studied in order to understand better the structure of the target nuclei and the nature of its interaction with the ion beam.

Investigation will cover the fields of nuclear structure, reactor design, radiation shielding design and material damage, among others.

Flight Utilizes Silvercel

Telemetering and data-recording equipment used in Major David G. Simons' recent record-breaking, 32-hour, 100,000-foot balloon flight utilized silver-zinc batteries.

Called Yardney Silvercel batteries and produced by Yardney Electric Corp., New York, N. Y., they make use of a silver-zinc couple. This is said to be up to five times more powerful than elements in other batteries. High energy ratio enables them to be as small as one-fifth the size and one-sixth the weight of batteries of comparable ampere-hour capacity.

One of these batteries accidentally fell 30,000 feet when a parachute to which it was attached failed to open after being released from a research balloon during a previous test. Not only did it survive the crash with only minor damage to its outer plastic casing, but, after recasing, the battery was placed immediately into service again.

Automatic Landing

Combining radio and radar, an automatic system has been developed that is capable of landing a fighter plane aboard an aircraft carrier. A Navy F3D jet has made repeated landings on the *Antietam*, operating in the Gulf of Mexico.

The system takes over from the pilot while the aircraft still is some distance from touchdown on a carrier deck. Radar locates the plane and determines its altitude and location with relation to the deck. An electronic computer does the rest, sending the necessary course corrections to an automatic pilot which directs the airplane into the desired flight path.

When the system "locks on" to the craft, the pilot immediately relinquishes control and rides virtually as a passenger.

If the carrier deck is not in the proper position for a safe landing, the system automatically gives the pilot a "wave-off" and the plane is flown around the landing pattern for another attempt.

In addition to over-all accuracy, the *Antietam* operations are evaluating the system with relation to longitudinal and lateral dispersion of the landings.

Previous to its actual use aboard the carrier, the device had landed various types of military and commercial aircraft more than 1800 times during development and testing at the Niagara Falls, N. Y. airport and at military installations.

The landing system was developed by Bell Aircraft Corporation, of Buffalo, N. Y., under contract with the Navy's Bureau of Ships.

British Develop Deccafax

A new communication system, which does not require the aid of a television camera to transmit pictures, has been developed by Decca Radar, Ltd., of London.

Called Deccafex, the system provides instant exchange of information by vision and sound between interconnected points in a closed circuit television layout.

According to the manufacturer, at present the development is capable of sending pictures and sound up to 2000 yards. The system is based on a new application of television operating principles.

Consisting of two "master" units connected by coaxial cables, the system's speech and vision directions are reversed by a single switch. Pictures are transmitted by placing transparencies on the screen of the sending unit, by using 35-mm slides or even by writing the information with a chinagraph pencil on the face of the tube itself.

Ordinary television receivers, while still able to perform as before, can be used to receive sound and pictures from the master unit.

Aside from the commercial potential, the manufacturers believe the system also will meet the requirements of airports, air traffic control centers, road and rail terminals, where a mass of incoming information must be collected and broken down for distribution.

Nems-Clarke Joins Vitro Corp.

Nems-Clarke, Inc., electronic manufacturers of Silver Spring, Maryland, recently became an operating division of Vitro Corporation of America. The Maryland firm will be known as Nems-Clarke Company and Mr. Allen S. Clarke remains as president.

Mr. Clarke stated that the new affiliation will result in expanded manufacturing and development activity. A reorganization of the development laboratory is in process to broaden the base of the company's proprietary products. While some changes in personnel would be necessary in order to accomplish this reorganization, Mr. Clarke further stated such changes would be kept to a minimum.

The company expects to greatly expand its development activity for the creation of new proprietary products in the fields of telemetry, medical electronics, photographic instrumentation and communications equipment.

Radiation Detectors

Army scientists in Nevada have used a new network of detectors to measure the amount of radiation following an atomic explosion. Tanks, balloons and underground positions serve as stations for the tests.

Developed at the U. S. Army Signal Engineering Laboratories, Fort Monmouth, New Jersey, the equipment keeps a continuous record of radiation hazards in the test area after a blast. The information is stored in well protected underground recorders until the section can be entered safely.

One type of spotter being used is designed to "pop up" from the ground like a periscope to compute the radiation at various distances from the blast. The instrument is kept underground as protection from the atomic shock wave. A split second after detonation, an automatic air gun jolts the detector into position. Remaining above ground for hours, it keeps a running account of fall-out.

A similar probe has been installed in a Sherman Tank to determine how close to the explosion a vehicle can be without danger to its crew.

A third set of instruments is attached to a balloon tethered at 1000 feet. The balloon burns instantly from the nuclear heat flash, but instruments have time to send readings through coaxial links to the recorders.

The scientists hope to ascertain under what conditions attacking troops can move into a section after striking with atomic artillery.

Daystrom Forms Avionics

Daystrom, Inc., has announced a major reorganization of certain subsidiaries into an Avionics Group for development and manufacture of complete electronic systems for the guidance and control of missiles and aircraft.

Involved in the move are Daystrom Pacific Corp., Santa Monica, Calif., which manufactures gyroscopes, potentiometers and other miniature electronic equipment; Daystrom Transicoil Corp., Worcester, Pa., which produces servo-mechanisms; Daystrom Instrument Division, Archbald, Pa., which manufactures electronic computer equipment and precision subassemblies; the Aircraft Instruments Division of Weston Electrical Instrument Corp., Newark, N. J., which will supply specialized equipment to the new group; and special research and development facilities at Poughkeepsie, N. Y.

Commenting on the activities of the new group, Thomas Roy Jones, president, said, "The Daystrom Avionics Group will offer a single source for guidance and control systems and also has the necessary tools and facilities for the fabrication and assembly of all other missile components."

Names In The News

Thompson H. Mitchell, President, RCA Communications, Inc., has been appointed general manager of the organization's Telecommunications Division. Mr. Mitchell will direct the integration of communication and broadcasting activities of the former Commercial Electronic Products group with RCA Communications, Inc.

Lt. Colonel Kenneth E. Shiflet has been named Chief of Technical Liaison in the Office of the Chief Signal Officer. He succeeds **Lt. Colonel L. J. Fishkin** who was recently appointed Special Assistant to the Chief Signal Officer.

Dr. Irving Langmuir, world-famous scientist, died at Falmouth, Mass. He was 76 years old. The Nobel-prize winning scientist was on the staff of the General Electric Research Laboratory from 1909 until his retirement in 1950. During his career at G.E., Dr. Langmuir's work was estimated to have saved the public nearly one billion dollars per year in electric light bills. In addition, he helped establish modern radio and television broadcasting.

(*Continued on page* 42)

TELEPHONE AND TELEGRAPH EQUIPMENT

Radio Engineering Products is currently producing a number of types of equipment, electrically and mechanically interchangeable with standard Bell System apparatus.

CARRIER-TELEPHONE EQUIPMENT

C5 Carrier-Telephone Terminal (J68756). A kit for adding a fourth toll-grade channel to existing C systems is available. • C1 Carrier-Telephone Repeater (J68757) • 121A C Carrier Line Filter • H Carrier Line Filter (X66217C).

CARRIER-TELEGRAPH EQUIPMENT

40C1 Carrier-Telegraph Channel Terminal (J70047C) • 140A1 Carrier Supply (J70036A1, etc.) • 40AC1 Carrier-Telegraph Terminal.

VOICE-FREQUENCY EQUIPMENT

V1 Telephone Repeater (J68368F) • Power Supply (J68638A1) • V1 Amplifiers (J68635E2 and J68635A2) • V3 Amplifier (J68649A) • V-F Ringers (J68602, etc.) • Four Wire Terminating Set (J68625G1) • 1C Volume Limiter (J68736C).

D-C TELEGRAPH EQUIPMENT

16B1 Telegraph Repeater (J70037B) • 10E1 Telegraph Repeater (J70021A) • 128B2 Teletypewriter Subscriber Set (J70027A).

TEST EQUIPMENT

2A Toll Test Unit (X63699A) • 12B, 13A, 30A (J64030A) and 32A (J64032A) Transmission Measuring Sets • 111A2 Relay Test Panel (J66118E) • 118C2 Telegraph Transmission Measuring Set (J70069K) • 163A2 Test Unit (J70045B) • 163C1 Test Unit (J70045D).

COMPONENTS AND ACCESSORIES

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Dr. John N. Mrgudich, Director of Human Resources, and **Joseph Weinstein**, mathematics consultant at Evans Signal Laboratory, have been awarded fellowships in the Secretary of the Army's Research and Study Program.

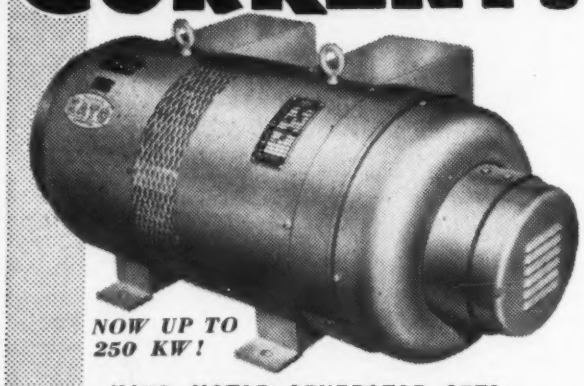
Loren E. Gaither has peen appointed Director of Communications Engineering for Philco Corporation's Government and Industrial Division. Mr. Gaither, who retired from the Army Signal Corps in 1955, was Director of Government and Industrial Engineering for the Magnavox Company.

Captain E. N. Dingley, Jr. (USNR-Inactive), a member of AFCEA and formerly Chief Communications Engineer of the National Security Agency, recently retired. He has accepted a position as a staff research engineer with Electronic Communications, Inc., St. Petersburg, Fla.

Brig. Gen. Albert F. Cassevant, now Director, Procurement Division, Office of the Deputy Chief of Staff for Logistics, has been designated to serve as Commandant of the U.S. Army Signal School at Fort Monmouth, N. J. He succeeds **Brig. Gen. Stuart S. Hoff.**

Colonel William E. Jennings was recently named the First Army Signal Officer, succeeding **Colonel C. B. Brown**, who retired from service. Colonel Jennings was Deputy Signal Officer.

Specify KATO 400 CYCLE CURRENT!



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Highlights from WESCON

This section is devoted to some of the items and events which comprised the Western Electronic Show and Convention held in San Francisco, August 20-23, 1957.

Precision transistorized timing instrumentation components were exhibited by the ***Electronic Engineering Company*** of California. The components are part of a completely transistorized system which was designed and developed by the company for the Air Force's Missile Range at Patrick Air Force Base.

A lightweight, underwater camera enclosure, designed to operate at depths up to 1200 feet, was introduced for the first time by the ***Hallamore Electronics Co.,*** division of The Siegler Corporation, Anaheim, Calif.

A completely transistorized combat computer for the U.S. Army was described by John Terzian, an engineer of ***Sylvania Electric Products, Inc.*** Called MOBIDIC, the computer will solve problems in a variety of fields including logistics, combat surveillance, scientific or analytic computation such as in traffic control and artillery target assignment.

An operating display of the "Indicoder" binary decoding tube was shown at the ***Stromberg-Carlson*** exhibit. When a group of such tubes is used in combination, they will form an electronic display board which can keep current, detailed information on scores of aircraft in the vicinity of an airport.

The first power tetrode in the electronics industry was unveiled by the ***Semiconductor Products Division of Minneapolis-Honeywell.*** Because this new type transistor faithfully reproduces input signals, it is expected to be used in the manufacture of high fidelity equipment.

The ***Anatran Division of Endevco Corporation,*** Pasadena, Cal., demonstrated a unique digital stepmotor that rotates in steps of 180° in response to voltage pulse inputs.

Electro-Mec Laboratory, Inc., Long Island City, N. Y., showed the first shaft-to-digit encoder designed for airborne use.

Intercontinental Dynamics Corp., Englewood, N. J., exhibited a low frequency noise generator which provides an electrical noise output for performance simulation of servos and other mechanical devices.

B J Electronics, Borg-Warner Corp., Santa Ana, Calif., exhibited the model 82 signal generator series, which is designed for general laboratory work and rugged field applications where high frequency, free from the adverse effects of environmental extremes, is required.

Jennings Radio Manufacturing Corp., San Jose, Calif., has produced a new type of relay for use under severe environmental conditions (e.g. missiles and aircraft) as well as in other electrical applications. The contacts of the new relay are in a vacuum surrounded by a sturdy stacked ceramic enclosure.

A new traveling wave tube weighing only two ounces has been developed at ***Geisler Laboratories,*** Menlo Park, Calif. It is believed to be the lightest traveling wave tube to date and does not require a capsule since the tube forms its own.

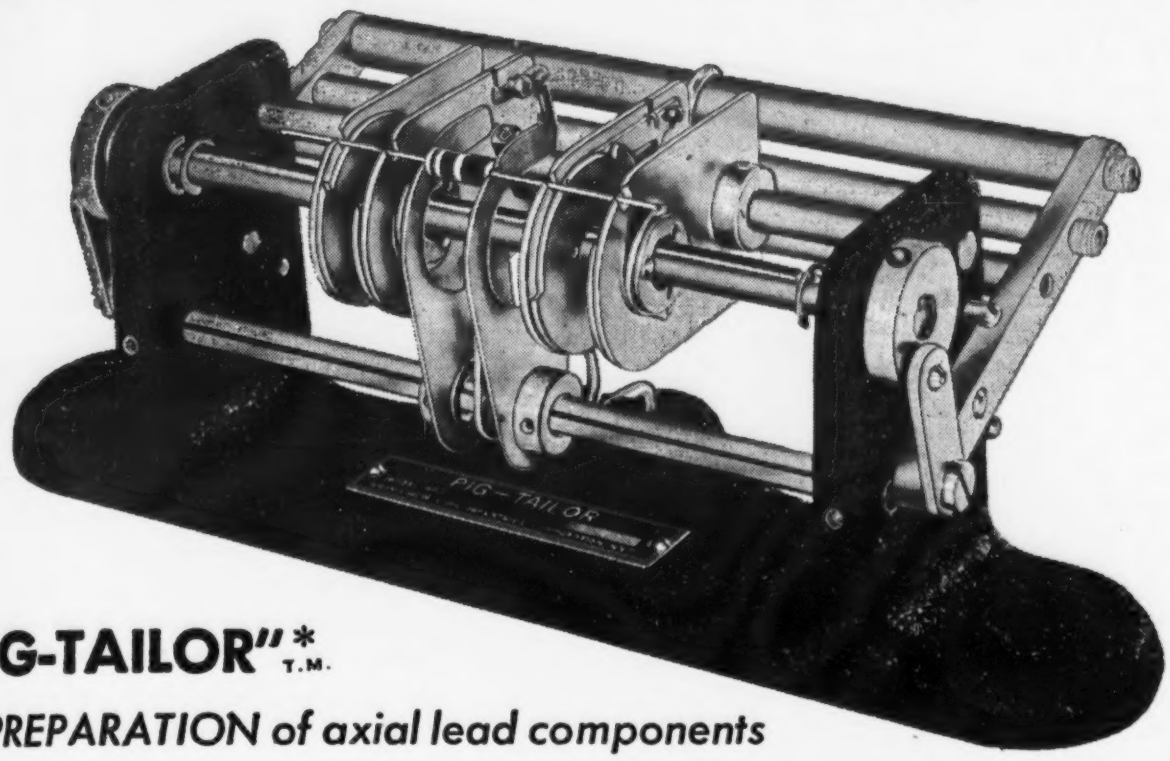
Visitors to the ***Texas Instruments, Incorporated,*** display witnessed the actual growing of large single crystals—from which semiconductor devices are made. A regular production crystal growing machine was set up to demonstrate the process.

The ***Hewlett-Packard Company,*** Palo Alto, Calif., announced a new instrument. The —hp— 560A Digital Recorder, the result of more than five years of research, is used to record the answers displayed on an electronic counter or counters.

The ***Aeronautical Division of the Robertshaw-Fulton Controls Company,*** Anaheim, Calif., exhibited a new liquid level switch for control of critical fuel levels in missiles and supersonic aircraft.

The ***General Electric Company*** unveiled its new 85-watt silicon power transistor publicly for the first time. The new transistor is thought to have the highest power rating of any high temperature transistor available.

PROVEN-on the assembly line!



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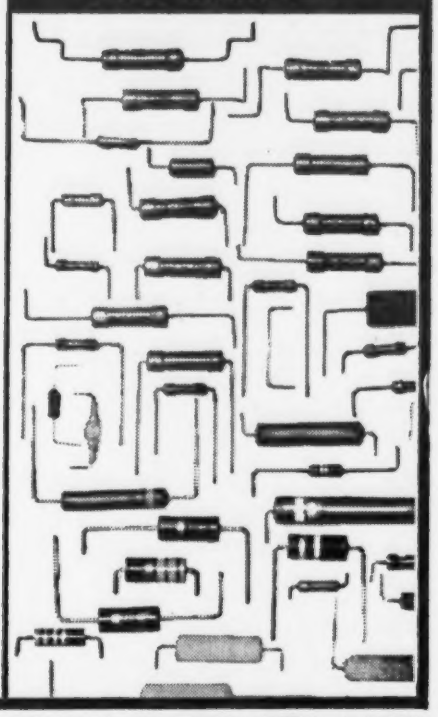

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. . . . a revolutionary new mechanical process for higher production at lower costs. Fastest PREPARATION and ASSEMBLY of Resistors, Capacitors, Diodes and all other axial lead components for TERMINAL BOARDS, PRINTED CIRCUITS and MINIATURIZED ASSEMBLIES.

The "PIG-TAILOR" plus "SPIN-PIN"—accurately MEASURES, CUTS, BENDS, EJECTS & ASSEMBLES both leads simultaneously to individual lengths and shapes—3 minute set-up—No accessories—Foot operated—1 hour training time.

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6. Individual cut and bend lengths.
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8. Closer cost control.
9. Invaluable labor saving.
10. Immediate cost recovery.

PIG-TAILORING eliminates:

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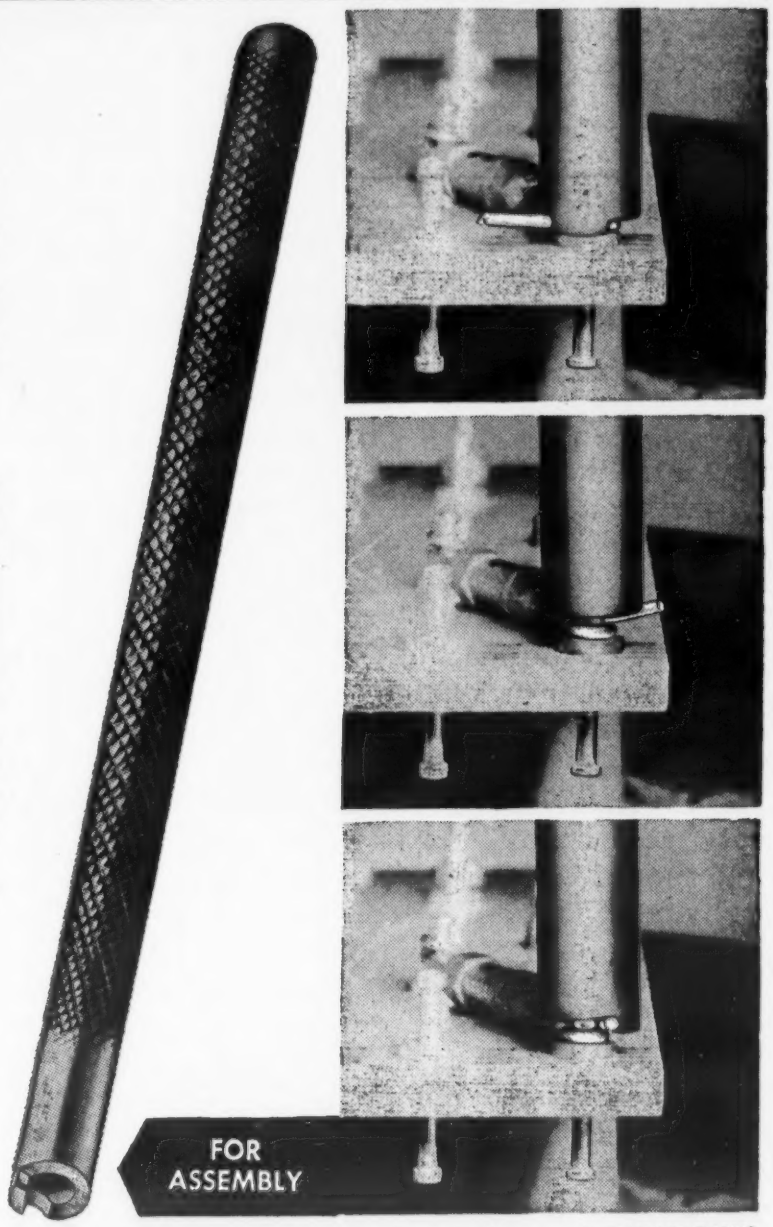
2. Long-nose pliers!
3. Operator judgment!
4. 90% operator training time!
5. Broken components!
6. Broken leads!
7. Short circuits from clippings!
8. 65% chassis handling!
9. Excessive lead tautness!
10. Haphazard assembly methods!



"SPIN-PIN"* T.M. Close-up views of "SPIN-PIN" illustrate fast assembly of tailored-lead wire to terminal.

*PATENT PENDING

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Stethoscope Shuts Off Unwanted Sounds

Airsonic, Ltd., of London, England, now offers a new stethoscope, said to be the first of its kind, which allows the doctor to shut out unwanted sounds and yet amplify those which are desired.

Since all sounds have a certain frequency, the device is designed with 2 controls that permit only a particular frequency to be carried to the ear pieces. A doctor, for example, can thus listen to the heart of a patient confined in an iron lung while the lung is still operating.

Suspended from the doctor's neck is a compact 18-oz. box containing the brain of the instrument. Two sets of ear pieces can be used simultaneously with a connected tape recorder and a loud-speaker. This feature provides a valuable aid for teaching purposes. Used with the stethoscope, the microphone conveys only the sounds from the source with which it is in contact.

New Mullard "510" Amplifier Kit

Featuring the addition of a separate pre-amplifier and control unit, together with the incorporating in the power amplifier of an output transformer operating under distributed load conditions, a new version of the Mullard "510" high fidelity amplifier kit has been announced by Mullard, Ltd., Torrington Place, London, Eng.

Both power amplifier and pre-amplifier units use up-to-date printed circuit techniques, and an accompanying instruction booklet enables easy, accurate assembly.

A 5-position selector gives a choice of inputs: LP and 45-r.p.m. discs; 78-r.p.m. discs; compensated tape; radio, and microphone. Separate bass and treble controls give, respectively, continuous variations in level from 10db at 40 cs, and 15db at 10 kcs.

Believed to provide exceptionally high performance, the power amplifier has a rated peak output of 10 watts, with a total harmonic distortion of only 0.1%. Frequency response is flat within 1db from 10 cs to 30 kcs. A salient feature lies in the amplifier's large margin of feedback stability, allowing for a diversity of loudspeaker and enclosure design, and affording flexibility in the remote siting of the loudspeaker from the amplifier.

Transistorized Telephone Receiver-Amplifier Aids Impaired Hearing

Development of a single-stage transistorized telephone receiver-amplifier which increases the level of incoming speech signals, thus offering particular aid to those with impaired hearing, has been announced by Stromberg-Carlson of Rochester, N. Y.

The compact device, enclosed in a molded plastic case measuring 4 x 2¾ x 1¼ inches, can be installed with any standard telephone, whether desk or wall-mounted.

An adjoining 4-conductor 3-foot cable, coupled to the points where the receiver is normally connected, is sufficient to put the unit into operation. When the handset is removed from the hookswitch, the device is immediately energized.

Ultrasonic Surgery

A new medical technique, called "neurosonic surgery," is now possible through the development of precision ultrasonic focusing instruments, recently designed by Professor Fry and associates of the University of Illinois, and now available from Invengineering, Inc., Belmar, N. J.

The first human brain surgery using the new ultrasonic apparatus is scheduled to be performed this month at the University of Iowa. Professor Fry believes ultrasonic techniques have further application in the destroying of bone tumors and cancerous cells in addition to the exploration of the central nervous system.

During the human brain surgery, deep lesions are formed in the brain which sever fiber tracts without damaging intervening tissues or destroying blood vessels. This procedure is said to represent considerable advance in technique. Dosage at 1 megacycle is delivered for 1 to 3 seconds. Larger lesions are possible by positioning the focal spot successively in a number of locations.

The positioning system is motor driven and controlled from an instrument panel. Supported by steel I-beams, it holds a demountable X-ray tube for determining proper location of the head. Exposure duration is set up on a series of dials reading directly in decimal notation. The sound level is set up by reading the deflection of a pointer on a single meter.

Recordak Engineering Drawing System

Recently developed by Recordak Corp., 415 Madison Ave., New York 17, N. Y., a subsidiary of Eastman Kodak Co., a new card system of filing engineering drawings, using 35mm microfilm images mounted in aperture cards, is claimed to offer great savings of time and cost in the filing of and reference to drawings and economical distribution of necessary paper reproductions.

While working on new designs, engineers have ready reference to the drawings on the Recordak Reader at the drafting board. Consequently, time and cost of reference paper copies is eliminated. Required filing clerks are fewer and equipment space is 95% reduced.

Original drawings are microfilmed and processed, and then can either be mounted on a tabulating aperture card for use in electronic sorting machines or on a plain file card for manual filing. Duplicate sets of cards can be made economically for quick dispersion to other plants.

From these aperture cards, full or reduced-size drawings can be reproduced for manufacturing or bid purposes at great savings in paper costs, shipping costs and time. It is said one Government agency, now engaged in this method, is saving an estimated $500,000 annually.

New Amplifier Klystron Tube

A new, wide-tuning-range klystron amplifier tube, having internal resonant cavity circuits capable of tuning from 1700-2400 megacycles, has been announced by Varian Associates of Palo Alto, Calif.

Known as the VA-800, the new tube is one of a line of high-power, high-gain, low-noise CW power tubes delivering 10kw and 1kw of power for tropospheric communication service in the frequency range from 375 mc to 8500 mc.

RF connections to the new VA-800 are merely an input line with less than 1 watt of drive power and an output line to carry 10,000 watts of rf power to the antenna. All resonant circuits are an internal part of the tube, and can be tuned readily to any spot in the 1700-2400 mc band. No other adjustments are said to be required for continual optimum operation.

Liquid Levels Measured In Remote Storage Tanks

"Data-Gage," a new transistorized electronic system claimed to measure the liquid level in any of 100 remotely located storage tanks with accuracy of performance, reliability and automatic self-checking, has been developed by Texas Instruments, Inc., Dallas 9, Texas.

Major components of the system are a receiver console, field selector unit and liquid level gauge embodying a float of completely new design. Either the entire system may be installed at the tank site, or a receiver console may be installed at a remote office any distance away.

On a single system, liquid depth to 64 feet in each tank may be measured with a claimed accuracy of 1/16 inch.

Desiring to monitor a specific tank, the operator dials and is connected through the field selector unit to the liquid level gauge on that particular tank. A dynamic mechanical surface finder is activated and the data is telemetered to the receiver console where it appears in lighted numerals. No wires enter the tank and installation requires no halt of operation.

The Automatic Chemist

The Titromatic Analyser, an apparatus said to perform the work of two skilled chemists in the continuous analysis of a chemical process during manufacture, is now available from the Instrument Div. of Robertshaw-Fulton Controls Co., 2 West 45th St., New York 36, N. Y.

With the apparatus connected to the main plant stream, a measured quantity of the solution being manufactured is fed to a reaction vessel at regular intervals. After dilution with water, titration with a standard reagent begins and continues until the solution has been completely neutralized.

The amount of reagent used is determined by an "electric eye" that finds the level of the reagent and then records the volume used on a recorder chart. Thus, this continuous record enables instant detection of variations in the plant stream and use of corrective measures. Meanwhile, the reaction vessel is emptying itself and the whole process starts again.

Composed of two separate units—one chemical and the other the electronic control—the apparatus is designed to operate continually and the time cycle of a titration can be varied from once every 3 minutes to once every half hour.

Moving Target Simulator

A precision piece of test equipment, designated the "moving target simulator," has been recently developed by Aircraft Armaments, Inc., of Cockeysville, Md., for the purposes of checking radar range tracking circuits, of calibrating radar range marker circuits, and of performing other tests on either K or Ku-band radar equipment.

The simulator provides a microwave return signal with pulse characteristics identical to that of the transmitted radar signal. The return signal may be adjusted to have a continuously varying range, and then used to check the radar range tracking circuits. However, it is said the unit will also provide a series of fixed range echo pulses of extreme accuracy for calibration of radar range markers. The unit may be connected to the radar set directly through a directional coupler, or may be used with a pick-up horn antenna.

A transit case offers convenient portability of the unit and its required accessories. However, the simulator may be mounted in a standard relay rack for laboratory use.

Ultrasonic Cleaner

Designed for industrial cleaning of small precision parts, a portable, lightweight, ultrasonic cleaner, Glennite Model U-621, has been announced by the Vibro-Ceramics Division of Gulton Industries, Inc., Metuchen, N. J.

In as little as 5 seconds, it is said the U-621 can clean small metal parts, glass and ceramic, such as electromechanical instruments, small aircraft instruments, watch parts, small diameter tubing, and delicate research and medical instruments.

A further application exists in the chemical industry for the agitation of liquids and for experimental processing such as emulsification and demulsification.

New Beam Power Amplifier

Production of an audio beam power amplifier, claimed to provide maximum reliability in high ambient temperatures, has been announced by Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.

Designated "Type SN-2146B," the new tube, which makes use of the stacked ceramic construction, is capable of 4.5 watts power output under class A conditions. Designed primarily for military equipment manufacturers, the tube is said to offer greater resistance to heat, shock, vibration, altitude and humidity than types previously available.

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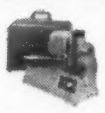

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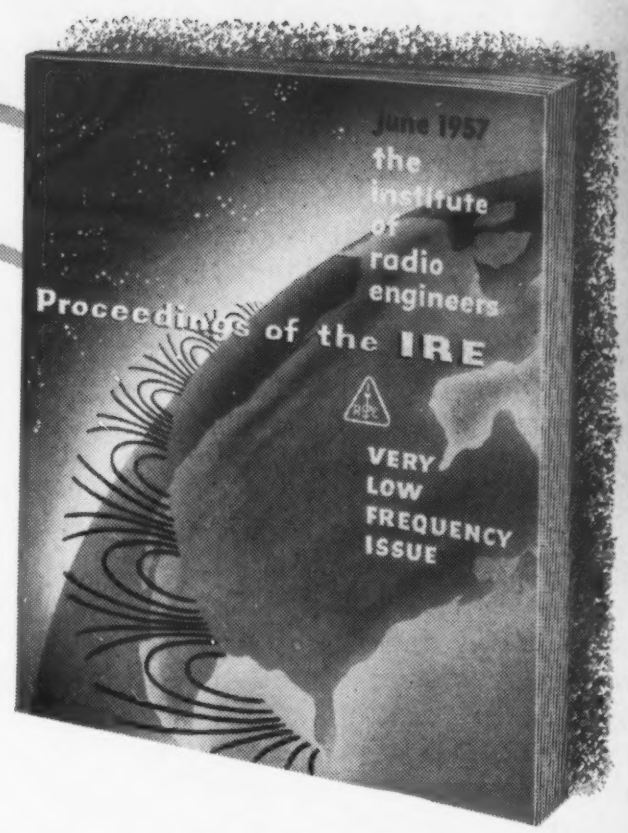

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Smaller antennas, lower transmitter power, and relative freedom from atmospheric noise are reasons behind our communication services' gradual migration to the upper end of the frequency spectrum. Lying fallow and awaiting rediscovery has been the very low frequency band below 30 kc.

Now, because VLF offers a reliable means of communicating over vast global distances, there is a marked revival of interest. It is now known that VLF has highly stable propagation characteristics which make it possible to transmit data to distant points with unusual fidelity and precision. Where greater accuracy is required, such as very long range radio navigation systems and international transmission of frequency standards, VLF promises to open doors to many new and important uses.

June Proceedings of the IRE gives you the facts about VLF

This year, the Boulder Laboratories of the National Bureau of Standards and the IRE Professional Group on Antennas and Propagation co-sponsored a Symposium at Boulder, Colorado, on the propagation of very low frequency radio waves. From the papers given at this important meeting the editors of *Proceedings* have chosen those of broadest interest for publication in the June, 1957, issue.

Typical of the service offered members of IRE is this VLF report — to be used now and referred to for years to come. If you are not a member of *The Institute of Radio Engineers* be sure to reserve a copy of the June *Proceedings of the IRE*, today!

Partial Contents of this VLF issue:

"A Technique for the Rapid Analysis of Whistlers," by J. K. Grierson, Defense Reserve Board, Ottawa, Ontario, Canada.

"VLF Radiation from Lightning Strokes," by E. L. Hill, School of Physics, University of Minnesota.

"Some Recent Measurements of Atmospheric Noise in Canada," by C. A. McKerrow, Defense Reserve Board, Ottawa, Ontario, Canada.

"Intercontinental Frequency Comparison by Very Low Frequency Radio Transmission," by J. A. Pierce, Croft Laboratory, Harvard.

"The Mode Theory of VLF Ionospheric Propagation for Finite Ground Conductivity," by James R. Wait, National Bureau of Standards, Boulder, Colorado.

"The Geometrical Optics of VLF Sky Wave Propagation," by J. R. Wait & A. Murphy, National Bureau of Standards, Boulder, Colorado.

"Characteristics of Atmospheric Noise from 1 to 100 Kc/s," by A. D. Watt & E. L. Maxwell, National Bureau of Standards, Boulder, Colorado.

"The Present State of Knowledge Concerning the Lower Ionosphere," by A. H. Waynick, The Pennsylvania State University.

"Noise Investigation at VLF by the National Bureau of Standards," by W. Q. Crichlow, National Bureau of Standards, Boulder, Colorado.

"Reflection at a Shapely-Bounded Ionosphere," by I. W. Yebroff, Stanford University.

"The Attenuation Versus Frequency Characteristics of VLF Radio Waves," by J. R. Wait, National Bureau of Standards, Boulder, Colorado.

"The Waveguide Mode Theory of the Propagation of VLF Radio Waves," by K. G. Budden, University of Cambridge, England.

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Books

HANDBOOK OF PIEZOELECTRIC CRYSTALS FOR RADIO EQUIPMENT DESIGNERS, PB 111586R, by J. P. Buchanan. OTS, U.S. Department of Commerce, Washington 25, D. C. 702 pages, $7.00.

Recently released to industry as a guide for designers of military electronic devices, Mr. Buchanan's manual is a revised edition of the Air Force handbook of the same title issued in 1954.

Presenting a comprehensive examination of piezoelectric control of radio frequencies, the manual includes background material, circuit theory, components data and all information essential to the application of piezoelectric crystal oscillators.

In addition to a 430-page division given to general coverage, other sections discuss application of crystal unit, holders and ovens recommended for use in equipment of new design.

The illustrated volume also includes a bibliography containing some 900 entries together with a list of manufacturers.

PRINCIPLES OF ELECTRIC AND MAGNETIC CIRCUITS, by Warren B. Boast, Ph.D. Harper & Brothers, New York. 369 pages, $5.50.

Dr. Boast's second edition, like the first, is designed to give a full comprehension of electric and magnetic circuits to the undergraduate student.

However, the section treating electric energy sources has brought the text up to date relative to improvements in solar sources. In Part IV (a presentation of the methods of electric network analysis), sections have been expanded to include discussion and further examples on situations involving voltage sources in circuits where a direct application of basic principles would render the circuits indeterminable of solution.

In addition, a more exact mathematical treatment of the combination of the compensation theorem and the superposition principle is offered. Although the English units of magnetic potential gradient and flux density are emphasized, the rationalized MKS system of units is also employed.

More than 300 problems are provided the student for testing his ability to apply theory.

ACOUSTICAL ENGINEERING, by Harry F. Olson. D. Van Nostrand Co., Inc., Princeton, N. J. 718 pages, $13.50.

For radio, TV, sound motion picture and recording engineers, architects and musicians, this newly enlarged edition makes available the most up-to-date information in modern acoustic science, and offers complete working methods covering the entire field of acoustical engineering.

In addition to the most recent developments in underwater acoustics, ultrasonics, architectural considerations and new musical instruments, the two new chapters treat sound reproducing systems and communications systems.

Since reducing a vibrating system to the analogous electrical network has been found a valuable tool in an analysis of that system, there is made throughout the volume a logical use of analogies between electrical, mechanical and acoustical systems. Detailed presentations of theory and practice are given concerning important transducers, and the material on speech, music and hearing correlates objective and subjective acoustics.

"LIFE" PHOTOGRAPHERS—THEIR CAREERS AND FAVORITE PICTURES, by Stanley Rayfield. Doubleday & Co., Inc., New York 22, N.Y. 89 pages, 14" x 10½", case-bound, coated stock, $5.00.

In compiling this unique anthology concerning 40 *Life* photographers, Stanley Rayfield has traced the careers and specialties of the entire *Life* photographic staff, from the original four in 1936 to the youngest, who was just 6 years old when the picture magazine was born.

Rather than giving a definitive record of any one photographer's work, a demonstration of individual approaches to picture-making and photo-journalism is offered and illustrated with 228 black-and-white photographs. *Life* photographers "hope that out of the thousands of negatives they shoot will come a truly great picture once in a while and many of them have pictures that are a permanent contribution to photography. Today the editors look at ½ million pictures a year to find the 10,000 they will print. The odds 'against' a picture running in *Life* are about 50 to 1."

Of special interest to those interested in photography is a section of the book on *Life* photographic technique and equipment.

UNDERSTANDING HI-FI CIRCUITS, by Norman H. Crowhurst. Gernsback Library, Inc., New York 11, N.Y. 224 pages; $2.90—paperbound edition, $5.00—hard-bound edition.

Although assessing high-fidelity performance is generally regarded a matter of taste, its circuitry is completely scientific. With the rapid progress in the science of audio circuitry during the last decade, there has arisen, however, some confusion in the evaluation of the variety of circuits available.

For the engineer, technician, musician or layman, Mr. Crowhurst has endeavored to divide the whole audio or high fidelity system into sections, explaining pertinent technical points that lend themselves easily to confusion, such as, output stages, matching, equalization, speaker crossovers, volume and tone controls.

The concept of proper integration of parts, considering the system as a whole, is presented to reveal as invalid the idea that the best result is obtained merely by a grouping of all the "best" parts.

In most sections there are at least two approaches—one simple and one complex. Additional consideration of such circumstances as budget, taste in programs, critical listening habits, etc., permits the reader to make his own particular compromise.

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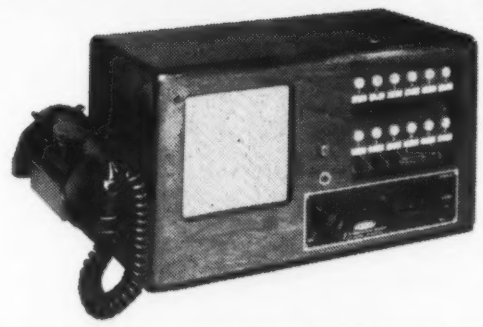

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a Standard for Reliability

PHOTOGRAPH COURTESY THE MARTIN COMPANY

Large-scale electronic manufacturers require fast and reliable tube-testing methods. To meet this need, The Martin Company of Baltimore has developed a high-speed precision tube tester which complies with all the test requirements of MIL-E-IC specifications.

The General Radio Vacuum-Tube Bridge has been incorporated in the tester to allow the operator to make periodic comparison measurements and thus maintain tester accuracy. The Vacuum-Tube Bridge is ideally suited to act as watch dog. It not only measures amplification factor, dynamic plate resistance, and transconductance directly, but performs each measurement independently of the other. Cross checks can be made at any time using known mathematical relationships. Interelectrode and stray capacities can be easily balanced out — thus eliminating awkward and cumbersome correction factors. Negative coefficients can be measured as readily as positive values. For these many reasons, Martin uses the General Radio Vacuum-Tube Bridge as their standard for measuring tube reliability.

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Accuracy: ±2% when r_p is somewhere between 1 kilohm and 1 megohm; at lower and higher values of r_p the error increases slightly.

Tube Mounting: Ten different adaptor plates are furnished for mounting all commonly used tubes. An additional "universal" adaptor is supplied for use with unmounted or nonstandard tubes. Extra sockets are also provided for transistors and subminiature tubes.

Current and Voltage Ratings: Maximum allowable plate current and voltage is 150 ma and 1500 volts, respectively. An external power supply is required.

Transistor parameters — both forward and reverse voltage amplification factor, resistance, and transconductance can be measured quickly and easily. From these measurements, two of the more common parameters (h_{11} and h_{12}) are given directly; the other two (h_{21} or α and h_{22}) are readily calculated.

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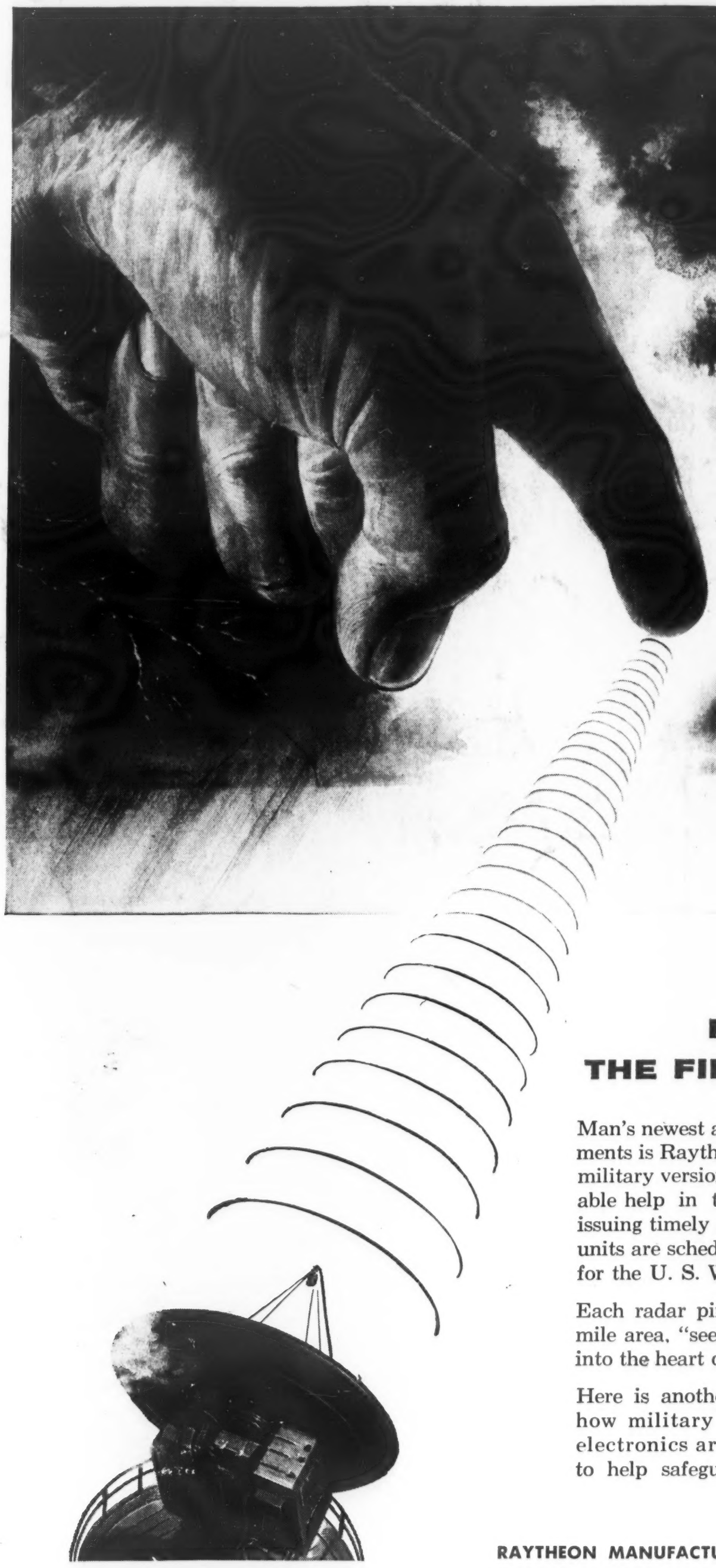

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